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(Third and Fourth) Annual Reports

OF THE

**HYDRO-ELECTRIC POWER
COMMISSION**

OF THE

PROVINCE OF ONTARIO

FOR YEAR ENDED OCTOBER 31st

1910/1911

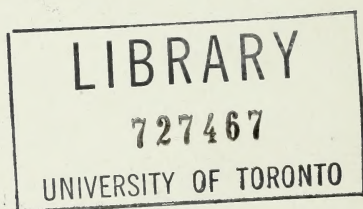
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1912

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To His Honour SIR JOHN MORISON GIBSON, K.C.M.G.,
Lieutenant-Governor of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to Your Honour the Third and Fourth Annual Report of the Hydro-Electric Power Commission of Ontario for the fiscal year ending October 31st, 1911.

Respectfully Submitted,

ADAM BECK,
Chairman.

TORONTO, FEBRUARY 1ST, 1912.

HONOURABLE ADAM BECK,
Chairman, Hydro-Electric Power Commission,
Toronto, Ont.

Sir,—I have the honour to transmit herewith the Third and Fourth Annual Reports of the Hydro-Electric Power Commission of Ontario for the fiscal year ended October 31st, 1911.

I have the honour to be,

Sir,

Your obedient servant,

W. W. POPE,
Secretary.

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

HON. ADAM BECK, London, Chairman.

HON. JOHN S. HENDRIE, C.V.O., Hamilton, Commissioner.

W. K. McNAUGHT, Esq., M.P.P., Toronto, Commissioner.

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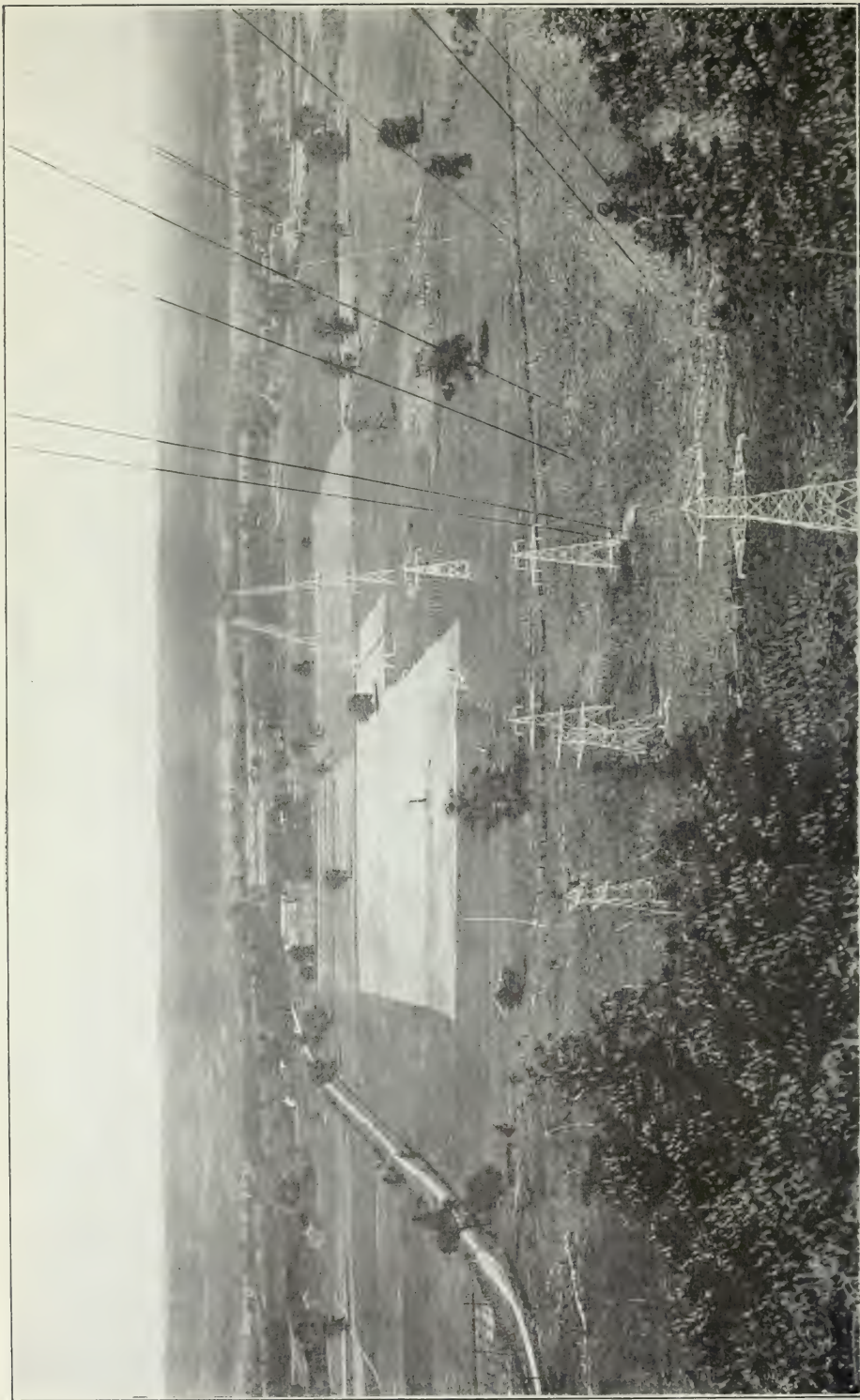
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Transmission Lines in the Dundas Valley.

THE THIRD AND FOURTH ANNUAL REPORTS OF THE Hydro-Electric Power Commission.

CHAPTER I. ACTS AND AGREEMENTS.

ACTS.

The following Acts concerning the Hydro-Electric Power Commission were assented to by the Legislature of the Province of Ontario during the Sessions of 1910 and 1911:—

An Act respecting the Hydro-Electric Power Commission of Ontario.

An Act to provide for the local distribution of Electric Power.

An Act to amend the Power Commission Act.

An Act to confirm certain contracts entered into by the Hydro-Electric Power Commission of Ontario.

An Act respecting The Hydro-Electric Power Commission of Ontario.

(10 Ed. VII., chap. 16.)

Assented to 19th March, 1910.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

1. It is declared that Section 10 of the *Power Commission Amendment Act, 1909*, conferred upon "The Hydro-Electric Power Commission of Ontario" absolute authority without the consent of the owners or persons interested and without any pre-requisite or preliminary action or proceeding whatsoever, and without any other sanction or authority, to enter upon any lands required for the purpose of constructing, erecting, maintaining and operating thereon the transmission lines and works in connection therewith referred to in said section and to retain possession thereof for such time as the Commission should think proper and under agreement with the owners or

Powers of entry for construction of line, etc., under 9 Edw. VII., c. 19, s. 10.

persons interested or without their consent and without any prerequisite or other sanction or authority whatsoever to take and acquire such right, title, privilege, easement, or interest in, over, upon or in respect of or relating to said lands as to the Commission might seem desirable or expedient.

Right of owner to compensation.

2. Whenever the Commission acts or has acted under the authority conferred by said section 10 compensation shall be made to the owners or persons interested for all damage to said lands necessarily resulting from the exercise of the powers granted to the Commission by said section. Provided always that in fixing such compensation regard shall in all cases be had to the nature and extent of the estate, right, privilege, easement or interest which the Commission decides to take and acquire in, over, upon or in respect of the said lands, and any assessment of damage shall be based thereon. The claimant shall present his claim for damages to the Commission in the manner provided for presentation of claims under Section 40 of *The Ontario Public Works Act*, and the provision of said Section 40 shall apply in respect of such claim, and in the event of no agreement being arrived at the amount of such damages may be determined by arbitration under *The Ontario Public Works Act*, in which case the provisions respecting arbitration contained in the said Act shall, *mutatis mutandis*, apply, or should such claimant elect by notice in writing within one month from the entry on the taking possession by the Commission, the amount of such compensation shall be determined in the manner provided by *The Arbitration Act* and subject to the provisions thereof.

9 Edw. VII., c. 35.

Payment or disposition of compensation.

3. When the Commission has agreed on the purchase price or rental, or the amount of compensation has been determined by arbitration under either of the said Acts, all the provisions of *The Ontario Public Works Act* as to payment or other disposition of the moneys payable in respect of the estate, right, title or interest purchased, leased or taken by the Commission and as to the vesting of such estate, right, easement or interest, and the title thereto, in the Commission shall *mutatis mutandis* apply.

7 Edw. VII., c. 19, s. 22, amended.

4. Section 22 of *The Power Commission Act* is amended by substituting for sub-section 4 the following sub-section:—

Orders and regulations of Commission.

(4) The Commission may from time to time make orders and regulations as to the construction, operation, protection, and inspection of the works, plant, machinery, appliances and equipment for transmission and distribution of electrical power by municipal corporations, and railway, power, or transmission companies.

Penalty for disobedience to order of Commission.

(5) Any municipal corporation, company or person neglecting or refusing to obey and carry out the order or direction of the Commission or the member thereof before whom the complaint was heard, or to comply with any order or regulation under the next preceding sub-section, in addition to any other

liability, shall forfeit to His Majesty for the uses of the Province the sum of \$100 for every day during which such refusal or neglect shall continue. 6 Edw. VII. c. 15, s. 19.

5. Section 2 of *The Power Commission Amendment Act, 1909*, is ^{9 Edw. VII, c. 19, s. 2,} amended by adding thereto the following clauses: ^{amended.}

(f) By adding the Corporations of the City of Hamilton and the Town of Tillsonburg as parties of the second part, and inserting in said schedule the word "Hamilton" in Column 1 and in Columns 2, 5, 6, and 7, opposite that word, the figures "1,000," "17.92," "84,384," and "3,620," and the word "Tillsonburg" in Column 1, and in Columns 2, 5, 6, and 7, opposite that word, the figures "500," "33.00," "84,713," and "6,892."

(g) By striking out paragraphs 1 (b), 2 (b), 10, and the last sentence of 11, and substituting thereto respectively:— ^{Agreement with municipalities}

1. (b) On June 1st 1910, or on any earlier date on which the Commission may be prepared to supply the same after one month's notice from the Corporation to supply 1,000 horse power to the Corporation within the limits thereof, ready for distribution, at approximately the voltage set forth in Column 4 of the schedule hereto, and approximately 25 cycles per second.
2. (b) The Corporation of the City of Hamilton shall not be bound to take power exclusively from the Commission, and shall at all times be at liberty to take power from any other source, or generate power, and the power supplied by the Commission may be used by the Corporation of the City of Hamilton for any purpose, except as set forth in paragraph 11 hereof.
10. (a) The Commission shall at least annually adjust and apportion the amounts payable by Municipal Corporations for such power and such interest, sinking fund, line loss, and cost of operating, maintaining, repairing, renewing and insuring the line and works "rateably according to the distance from Niagara Falls and amount of power supplied to the Corporation of the City of Hamilton, subject to the provisions of paragraphs 10 (b) and (c)."
- (b) The Municipal Corporation of the City of Hamilton shall be entitled, in respect of the said amounts payable by the said Municipal Corporation, to any reduction that may be due to increase in the quantity of power supplied to the said Municipal Corporation.
- (c) The said Municipal Corporations shall not be entitled, in respect of said amounts, to any reduction that may be due to increase in the quantity of power supplied by the Commission to any other corporations or parties.

- (d) At any time prior to the 31st December, 1910, the said Municipal Corporation may agree to insert paragraphs 2 (b) and 13 (a) and (b) of the agreement of May 4th, 1908, in this agreement, and thereafter paragraph 10 (b) of this agreement shall be of no effect, and the said Municipal Corporations shall be entitled to all rights and benefits of said agreement of May 4th, 1908, as if originally a party thereto.

No power shall be supplied by any municipal corporation for the purposes of any railway, or for distribution other than by the municipality, without the written consent of the Commission.

- (h) By adding to paragraph 4:

Said meters shall be located by the Commission so as to prevent discrimination in the measurement of the quantity of power supplied to each municipality.

- (i) By striking out paragraph 13 and numbering paragraphs 14 and 15, 13 and 14.

- (j) The variations in the preceding sub-sections (g), (h) and (i) shall apply to the contract with the Corporation of the City of Hamilton only.

By-laws of
Hamilton
and Tillson-
burg con-
firmed.

6. By-law numbered 906 of the said Corporation of the City of Hamilton, and by-law numbered 605 of the Town of Tillsonburg, are declared to be sufficient, legal, valid, and binding for the purpose thereof, and the contract executed by the said Corporations and the Commission shall be legal, valid and binding on the parties thereto, notwithstanding that the provisions of the first sentence of paragraph 11 have not been fully complied with.

An Act to provide for the Local Distribution of Electrical Power.

(1 Geo. V., chap. 14.)

Assented to 24th March, 1911.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

Short title.

- 1.** This Act may be cited as "*The Power Commission Act, 1911.*"

Interpreta-
tion.

- 2.** In this Act

"The Com-
mission."

- (a) "The Commission" shall mean the Hydro-Electric Power Commission of Ontario;

"Corpora-
tion."

- (b) "Corporation" shall mean the Corporation of a city, town, township or village municipality.

3. Any one or more of the ratepayers in a municipality, the corporation of which has not entered into a contract with the Commission under *The Power Commission Act*, may apply to the Corporation to obtain from the Commission a supply of electrical power or energy for the use of such ratepayer or ratepayers for lighting, heating and power purposes or for any of such purposes.

4. The application shall be in writing signed by the applicants and shall state the lots or parts of lots owned or occupied by each of them respectively, and the purposes for which the electrical power or energy is required.

5. The Council of the Corporation shall thereupon request the Commission to supply the electrical power or energy for the purposes mentioned in the application.

6. Upon such request The Commission shall furnish to the Corporation an estimate of the maximum cost per horse power at which the electrical power or energy will be supplied at the point of development or of its delivery to The Commission and an estimate of the cost of constructing and providing transmission lines by means of which the amount of electrical power or energy required is to be supplied and of maintaining the same and may furnish to the corporation plans and specifications of the works, plant, machinery and appliances necessary for the distribution of such power or energy by the corporation to the applicants, and an estimate of the cost thereof and such other information as The Commission may think advisable.

7. Within one month after the delivery of the statement and estimates mentioned in the next preceding section, the Council shall, at a special meeting called for that purpose, and of which notice shall have been given to each of the applicants, consider the statement and estimates furnished by The Commission and with the consent of the applicants or such of them as shall signify their desire to proceed to enter into a contract for the supply of electrical power or energy by The Commission, the Corporation without submitting the same to a vote of the electors and without any of the other formalities required in the case of a By-law passed under *The Power Commission Act*, may pass a By-law for entering into a Contract with The Commission for the supply of the electrical power or energy required by the applicants, and may enter into a contract with the Commission for that purpose.

8. All the provisions of *The Power Commission Act* as to the annual payments to be made by corporations which have entered into contracts with The Commission shall apply to a contract entered into under this Act.

9. The contract may provide for the admission from time to time of further subscribers, or for the making of a contract between the Corporation and The Commission under *The Power Commission Act*, and the readjustment thereupon of the amounts payable annually to The Commission and of the amounts payable annually by the subscribers in

such manner as may be agreed upon or determined by arbitration or otherwise.

Issue of
debentures.

10. The By-law may provide for the issue of debentures of the municipality payable within twenty years from the issue thereof to meet the cost of construction and instalment of the works, plant, machinery and appliances necessary for the distribution of the electrical power or energy, and for the levying of a special rate for payment of principal and interest in the manner provided by *The Consolidated Municipal Act*, 1903.

3 Edw. VII.,
c. 19.

Amount
payable by
applicants.

11. The amount payable by the applicants in each year for the electrical power or energy supplied to them, shall be sufficient to recoup the municipality the amount required to pay the principal and interest of any debentures issued and to meet the annual payments required to be made to the Commission as provided by *The Power Commission Act*, and in default of payment any amount due to the corporation under this section may be entered on the collector's roll and collected in the same manner as other taxes.

7 Edw. VII.,
c. 19.

Contracts
with
Police
Trustees.

12.—(1) The trustees of a Police Village shall for the purposes of *The Power Commission Act*, be deemed a municipal corporation, and subject to the provisions of this Act, may exercise all the powers conferred upon municipal corporations by *The Power Commission Act*, and may enter into a contract with the Commission for the supply of electrical power or energy as provided by that Act.

Submission
of By-law
in Police
Villages.

(2) The council of the township, or the councils of the townships in which the Police Village is situate, upon the request of the Police Trustees, shall submit the By-law, provided for by section 13 of *The Power Commission Act*, to a vote of the electors of the Police Village qualified to vote thereon, and shall upon the like request issue debentures as provided by the said Act and levy and collect a special rate upon the rateable property in the Police Village for the payment thereof.

Township to
levy rates.

(3) The council of the township in which the Police Village or any part thereof is situate, shall annually levy by special rate upon the rateable property in the Police Village, or in that part of the Police Village situate in the township, the amounts required to meet the payments to be made to The Commission.

An Act to amend The Power Commission Act.

(1 Geo. V., chap. 15.)

Assented to 24th March, 1911.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

Short title.

1. This Act to be cited as *The Power Commission Amendment Act, 1911.*

2. In this Act

- (a) "Highway" shall include street, lane, road square or other public passage, and "Highways" shall have a meaning corresponding to that of highway. Interpretation
"Highway."
- (b) "The Commission" shall mean The Hydro-Electric Power Commission of Ontario. "The Commission."
- (c) "Works" shall include wires, pipes, poles, conduits, ducts and other fixtures, appliances or apparatus. "Works."
- (d) "Corporation" shall mean a municipal corporation and an incorporated company duly authorized by municipal by-law or agreement to construct and operate works for conducting, furnishing or distributing electricity for light, heat or power purposes in, under or upon any highway, and shall include any Board or Commission incorporated or unincorporated, acting on behalf of a municipal corporation or of the inhabitants of a municipality. "Corporation."

3.—(1) Where a corporation has constructed or desires to construct works for conducting, furnishing or distributing electricity for light, heat or power purposes, in, under, or upon any highway, or part of highway, in, under or upon which and other corporation has already constructed and has works for the like purposes, or any of them, upon the application of the first mentioned corporation and after notice to the other and hearing any objections which it may make, the Commission may, if it is of opinion that the location and mode of construction of such works are proper, approve of the same; and all works which such first mentioned corporation has constructed or may thereafter construct, the location and mode of construction of which have been so approved, shall be deemed to have been constructed under statutory authority and to be lawfully constructed and may be maintained and operated by such corporation without its incurring any liability to any other corporation in respect of the construction, maintenance or operation of such works, except that provided for by section 4, any statute or law to the contrary notwithstanding. Approval
of distribut-
ing works
of the
Commission.

(2) Such approval may be given subject to such conditions as the Commission may deem necessary to prevent injury to the works of the other corporation, or to such other corporation and its servants and workmen, in maintaining, repairing and operating them. Approval
upon
conditions.

(3) Where the Commission is of opinion that it is necessary or expedient in order to prevent danger from contact between the wires of the two corporations, or from any other cause, that insulators or other appliances should be affixed to the poles of either corporation, or that the wires of either of them should be attached to such insulators or other appliances, the Commission may authorize or direct such insulators or other appliances to be so affixed, and such wires to be so Insulation.

attached in such manner as the Commission may deem best calculated to prevent such danger; and anything done by either corporation pursuant to such authority or direction shall be deemed to be lawfully done.

Work to be done at expense of initiating corporation.

(4) Anything authorized or directed to be done under the provisions of subsection 3 shall be done at the expense of a corporation constructing the works in a locality in which works have already been constructed by another corporation, and under such supervision as the Commission may direct.

Powers exercisable from time to time.

(5) The powers conferred by this section may be exercised from time to time as occasion may require.

Application to works already constructed.

(6) The provisions of this section shall apply to works of a corporation constructed before the passing of this Act.

Claims for damages by one corporation against another.

4.—(1) If any damage or injury is done to the works of a corporation or any of them, or is occasioned in the maintenance or operation of them by reason of the works of another corporation, or any of them, being constructed or operated in closer proximity to the works of such first mentioned corporation than, but for the provisions of section 3, would have been lawful, no action shall lie in respect thereof, but the corporation doing such damage or injury shall make due compensation therefor, and any question or dispute as to such damage or injury having been so done or occasioned, or as to the amount of the compensation, shall be determined by arbitration, and the provisions of *The Consolidated Municipal Act, 1903*, with respect to the arbitration in the case of claims against municipal corporations shall apply *mutatis mutandis* to the procedure upon an arbitration under this section.

3 Edw. VII., c. 19.

Notice of Claim.

(2) The corporation claiming damages shall within one month after the coming into force of this Act, or within one month after the expiration of any calendar year, in which it claims that any such damage or injury has been so done or occasioned, give notice in writing to the other corporation of its claim and of the particulars thereof, and upon failure to do so the right to compensation in respect of the damage or injury done or occasioned prior to the coming into force of this Act, or during that calendar year shall be forever barred.

Approval of Commission may be pleaded.

5. Where the location and mode of construction of any works of a corporation which have been constructed before the passing of this Act are approved by the Commission under the provisions of section 3, the approval of the Commission may be set up in and shall be available as a defence to any action now pending to the same extent and with the same effect as if such action had been commenced after the passing of this Act, and the giving of such approval; and where it is so set up, the plaintiff shall be entitled to discontinue the action, and, if he does so, to be paid his costs of it by the defendant.

6. The Commission shall have exclusive jurisdiction as to all matters in respect of which authority is, by this Act, conferred upon it, and nothing done by the Commission within its jurisdiction shall be open to question or review in any action or proceeding or by any Court. Exclusive jurisdiction of Commission.

7. No Court shall have authority to grant, or shall grant an injunction, or other order, restraining, either temporarily or otherwise, the construction, maintenance or operation of any works, the location and mode of construction of which have been approved by The Commission if the same are being, or have been constructed in the place and according to the mode which have been so approved. Jurisdiction of courts ousted.

An Act to confirm Certain Contracts entered into by the Hydro-Electric Power Commission of Ontario.

(1 Geo. V., chap. 16.)

Assented to 24th March, 1911.

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

1. The municipal corporations of the Towns of Brampton, Dundas, Seaforth, Mitchell and of the Village of Weston, are added as parties of the Second Part to the contract set out as Schedule "A" to *The Power Commission Act, 1909*, as varied and confirmed by the said Act, and as further varied and confirmed by the Act passed in the 10th year of the reign of His Late Majesty King Edward 7th, Chaptered 16, and the said contract shall be binding as to the Town of Brampton from the 14th day of June, 1910, as to the Town of Dundas from the 7th day of November, 1910, as to the Town of Seaforth from the 19th day of December, 1910, as to the Town of Mitchell from the 25th day of December, 1910, and as to the Village of Weston from the 17th day of June, 1910. Amendment of contract by addition of Brampton, Dundas, Seaforth, Mitchell and Weston.

2. The names of the said municipal corporations are added to Schedule "B" to the said contract, and such schedule shall be read as containing the particulars set out in Schedule "A" to this Act. Addition to Schedule to contract.

3. By-law No. 316 of the Corporation of the Town of Brampton, By-law No. 671 of the Corporation of the Town of Dundas, By-law No. 86 of the Corporation of the Town of Seaforth, By-law No. 11 of the Corporation of the Town of Mitchell, and By-law No. 367 of the Corporation of the Village of Weston are confirmed and declared to be legal, valid and binding upon the said corporations and the rate-payers thereof respectively, and shall not be open to question upon any ground whatsoever notwithstanding the requirements of *The Power Commission Act*, or the amendments thereto or of any other statute. By-laws confirmed.

Contracts confirmed.

4. The contracts heretofore entered into by the said corporations respectively with the Commission are confirmed and declared to be legal, valid and binding upon the parties thereto respectively and shall not be open to question upon any ground whatsoever notwithstanding the requirements of *The Power Commission Act*, or the amendments thereto or of any other statute.

SCHEDULE A.

Additions to Schedule B to the contract set out in Schedule A to 9 Edw. 7, c. 19.

Name of Municipal Corporation.	Quantity of power applied for in h.p.	Maximum price of power at Niagara Falls.	No. of volts.	Estimate maximum cost of power ready for distribution in municipality.	Estimate proportionate part of cost to construct transmission line, transformer stations and works for nominally 30,000 h.p., with total capacity of 60,000 h.p.	Estimate of proportionate part of line loss and of part cost to operate, maintain, repair, renew and insure transmission line, transformer stations and works for nominally 30,000 h.p., with total capacity of 60,000 h.p.
Brampton	1,300	.....	....	\$29.40	\$179,132	\$15,690
Dundas	600	.....	....	17.33	32,160	2,892
Seaforth	400	.....	....	41.25	102,941	6,769
Mitchell	200	.....	....	38.50	47,490	3,066
Weston	250	.....	....	29.25	42,437	2,501

AGREEMENTS.

Additional agreements were made between the Hydro-Electric Power Commission and: The Ottawa and Hull Power and Manufacturing Company on the 6th day of December, 1910; The Municipal Corporation of the City of Ottawa on the 6th of December, 1910; The Simcoe Railway and Power Company on the 10th of February, 1911; The Town of Penetanguishene on the 2nd of May, 1911; The Town of Midland on the 20th of July, 1911; The Dominion Sewer Pipe Company on September 19th, 1911; and The Standard White Lime Company on the 15th of October, 1911.

MEMORANDUM OF AGREEMENT made this Sixth day of December, A.D., 1910.

BETWEEN :

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter called "The Commission,"

of the First Part.

and

THE OTTAWA AND HULL POWER AND MANUFACTURING COMPANY, LIMITED, hereinafter called "The Company,"

of the Second Part.

WHEREAS the parties hereto under an agreement dated the 31st day of July, 1907, entered into a contract for the firm, purchase and sale of fifteen hundred horse power, and for the provisional purchase and sale of an additional one thousand horse power:

AND WHEREAS the Commission has purchased and used the said additional power as well as the firm power contracted for, comprising in all the full amount of twenty-five hundred horse power contemplated in the agreement:

AND WHEREAS the Commission desires to purchase an additional amount of fifteen hundred horse power, and to transmit all the power acquired by means of a three phase transmission line operating at 11,000 volts as contemplated in the agreement:

AND WHEREAS the party of the Second Part has agreed to increase the said additional power by fifteen hundred horse power, and to sell the said fifteen hundred horse power under the same provisional conditions as agreed upon for the original one thousand horse power now firmly purchased:

AND WHEREAS the Company in consideration of the increased amount of power intended to be purchased as above set forth has agreed

to waive payment on the part of the Commission of the transformer rentals contemplated in the said agreement and therein expressed as a percentage of the capital cost of the transformer equipment.

NOW THEREFORE, the parties agree for the purpose of carrying out the intent of the aforesaid to amend the said agreement as follows:

1. Wherever in Clause 1 the words "one thousand horse power" appear these shall be changed to read "Twenty-five Hundred Horse Power."

2. Wherever in Clause 13 the words "twenty-five hundred horse power" appear these shall be changed to read "Four Thousand Horse Power."

3. From Clause 3 shall be deleted the following words: "And provided that if power is required to be delivered at approximately eleven thousand (11,000) volts, the Commission will pay the Company an additional amount per annum equal to fifteen per cent. (15%) on the market value of two transformers having sufficient capacity to raise the total amount of power contracted for herein from approximately two thousand three hundred (2,300) volts to approximately eleven thousand (11,000) volts, the value of the transformers to be based on the market price of transformers, equal in every respect, to those now installed in the power house of the Ottawa and Hull Power and Manufacturing Company—the market price to be that existing at the time change in voltage is ordered."

In all other respects the original agreement shall stand.

IN WITNESS WHEREOF the parties hereto shall set their hands and seals on the day and year first above written.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

[SEAL.]

HYDRO-ELECTRIC POWER
COMMISSION.

(Sgd) A. BECK, *Chairman.*

(Sgd) W. K. McNAUGHT.

THE OTTAWA AND HULL
POWER AND MFG. CO.,
LTD.

(Sgd.) M. WM. C. RAWAND,
President.

(Sgd.) R. BLACKBURN,
Secy.-Treas.

MEMORANDUM OF AGREEMENT made this Sixth day of December, A.D., 1910.

BETWEEN:

THE HYDRO-ELECTRIC POWER COMMISSION OF
ONTARIO, hereinafter called the "Commission,"
of the First Part,

and

THE MUNICIPAL CORPORATION OF THE CITY OF
OTTAWA, hereinafter called the "Municipal Corporation,"
of the Second Part.

WHEREAS the parties hereto under a contract dated 31st day of July, 1907, entered into an arrangement for the firm, purchase and sale of fifteen hundred horse power and for the provisional purchase and sale of an additional one thousand horse power, all subject to an agreement dated the 30th day of August, 1907, between the Commission and the Ottawa and Hull Power and Manufacturing Company, Limited, which said agreement was made a part of the contract.

AND WHEREAS the Municipal Corporation has purchased and the Commission has sold the full amount of twenty-five hundred horse power contemplated in the said contract and the said agreement.

AND WHEREAS the Municipal Corporation desires to purchase an additional amount of fifteen hundred horse power, and to transmit all the power acquired by means of a three phase transmission line operating at 11,000 volts as contemplated in both said agreement and contract.

AND WHEREAS the Commission under an amendment to the said agreement which is dated the Sixth day of December, A.D., 1910, and of which a copy is hereto annexed and made a part thereof, has provisionally purchased the required power and obtained the waiver of the Company to the transformer rentals contemplated in the said agreement.

AND WHEREAS the Municipal Corporation has agreed to accept the terms of the said agreement as amended, as if made by and between the Municipal Corporation and the Company.

NOW, THEREFORE, the parties agree for the purpose of carrying out the intent of the aforesaid to amend the said contract as follows:

Wherever the words "twenty-five hundred horse power" are found, these shall be changed to read "FOUR HUNDRED HORSE POWER."

IN WITNESS WHEREOF the parties hereto have set their hands and seals on the day and year first above written.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

[SEAL.]

HYDRO-ELECTRIC POWER
COMMISSION.

(Sgd.) A. BECK, *Chairman.*

(Sgd.) W. K. McNAUGHT.

CORPORATION OF CITY OF
OTTAWA.

(Sgd.) CHAS. HOPEWELL,

Mayor.

(Sgd.) JOHN HENDERSON,

City Clerk.

THIS AGREEMENT DATED THE 10th day of February, A.D., 1911.

BETWEEN:

THE HYDRO-ELECTRIC POWER COMMISSION OF
ONTARIO acting herein on its own behalf and with the approval
of the Lieutenant-Governor-in-Council, herein called the "Com-
mission,"

party of the First Part.

and

THE SIMCOE RAILWAY AND POWER COMPANY, herein
called the "Company"

party of the Second Part.

WHEREAS the Company was duly incorporated Chapter 145 of the Statutes of Ontario 9 (Edward VII) and Chapter 151 of the Statutes of Ontario 10 (Edward VII) and also entered into an agreement by way of a Lease with the Crown, bearing date the 7th day of September A.D. 1909, and numbered 1815. In pursuance of the said Acts and Lease, have erected a Power Plant on the Severn River, at a location known as the Big Chute, for the development, transmission and sale of Electrical Power, Light and Heat.

AND WHEREAS certain Municipalities have applied to the Commission for a maximum price of such power, and for estimates on the cost of transmission to such Municipalities.

AND WHEREAS the said estimates will be based in part upon this agreement and the Commission will be required to devote time and skill and expend moneys in preparation of such estimates, and such estimates are to be used for the purpose set forth in the Power Commission Act.

NOW THEREFORE THIS INDENTURE WITNESSETH that in consideration of the premises and of the mutual covenants and agreement herein, each of the said parties hereto agrees with the other as follows:

1. The Company hereby agrees;

(a) At the expiration of thirty (30) days' notice in writing from the Commission to the Company, to reserve and deliver when called for, 200 horse power or more of electrical power to the Commission. Said notice shall be given not later than July 1st, 1911. Initial quantity.

(b) At the expiration of thirty (30) days' notice in writing, which may be given from time to time during the continuance of this agreement, to reserve and deliver to the Commission, additional electric power when called for from time to time, in blocks of fifty horse power each, until 500 horse power is ordered to be reserved, and then in blocks of one hundred horse power each until the total amount so reserved and delivered shall amount to 1,600 horse power. Increments.

The Commission in giving notice as above, will specify approximately in what proportions any additional block of power is to be distributed among different points of delivery.

(c) The Commission shall not be bound to take or pay for any electric power until notice shall have been given as above provided.

2. The Company hereby agrees to reserve and deliver and the Commission agrees to purchase and pay for the said electric power on the terms and conditions of this agreement. Agreement.

3. The Commission agrees;

Procuring market.

(a) To use all diligence by every lawful means in its power to procure such a demand from the Municipalities, Corporations, Companies, or Persons for the power dealt with by this agreement, so that at as early a date as possible the Commission will be in a position to give the first notice above referred to, to the Company for the supply of power in question, and if notwithstanding the exercise of all such reasonable diligence the Commission is not able on or before the First day of July, 1911, to give such notice, then the Company shall be at liberty to determine the agreement and it shall thereupon be no longer binding upon the parties hereto.

(b) To pay the Company for such power reserved or taken under this agreement, subject to conditions of paragraph 5, and all other conditions of this agreement, as set forth hereunder, it being understood and agreed that demand for power as defined shall at the option of the Commission, refer either to 22,000 volt high tension power, or 2,200 volt low tension power, as required by the Commission from time to time, delivered respectively as set forth in paragraph 6 hereunder. Price.

For the initial 200 horse power, to pay \$21.00 per horse power per annum for any proportion thereof taken at 2,200 volt low tension, and \$20.00 per horse power per annum for any proportion thereof taken at 22,000 volt high tension.

When the demand shall have increased to 500 horse power, to pay

\$20.00 per horse power per annum for all of any proportion thereof taken at 2,200 volts low tension and \$19.00 per horse power per annum for all of any proportion thereof taken at 22,000 volt high tension.

When the demand shall have increased to 1,000 horse power, to pay \$19.00 per horse power per annum for all of any proportion thereof taken at 2,200 volt low tension, and \$18.00 per horse power per annum for all of any portion thereof taken at 22,000 volt high tension.

When the demand shall have increased to 1,500 horse power, to pay \$17.50 per horse power per annum for all of any proportion thereof taken at 2,200 volts low tension, and \$16.50 per horse power per annum for all of any proportion thereof taken at 22,000 volts high tension.

Additional
demand.

4. If, after the Commission has ordered 1,600 horse power as hereinbefore provided, additional power is required by the Commission same shall be provided by the Company according to the terms and conditions of this agreement or with such modifications thereof as may be agreed upon, providing the Company has the power available or capable of development.

Basis of
payment.

5. The Commission shall pay for three-fourths of the power ordered from time to time by the Commission and held in reserve for it as herein provided, whether it takes the same or not. When the greatest amount of power taken for any twenty consecutive minutes during any month shall exceed, during such twenty consecutive minutes, three-fourths of the amount ordered by the Commission and held in reserve, then the Commission shall pay for this greatest amount during the entire month.

If the Commission during any month takes more than the amount of power ordered and held in reserve for it for twenty (20) consecutive minutes, the Commission shall pay for this greatest amount of power during the entire month. The taking of such excess shall thereafter constitute an obligation on the part of the Commission to pay for, and on the part of the Company to hold in reserve, an additional block of power, in accordance with the terms and conditions of this contract.

A composite daily curve, derived from daily load curves taken at the various points of measurement in accordance with the method specified in paragraph 12, shall be compiled each month by the Commission, and these composite curves shall be used as a basis of payment for power used during the month to which they apply.

The power shall be paid for monthly in gold coin of the present standard of weight and fineness, in twelve amounts in each year at the office of the Company at Midland, Ontario. The composite curve shall be forwarded to the Company by the fifth day of the succeeding month, and bills shall be rendered by the Company on the tenth day and paid by the Commission on or before the twentieth day of each month.

Points of
delivery.

6. Under this agreement the points of delivery by the Company to the Commission for low tension and high tension power respectively, shall be as follows, namely:

(a) For 2,200 volt low tension power, at the low tension outlet bushings of the Company's step-down substation as now located at the outskirts of the Town of Midland, Ontario, the power so taken shall be measured at the 2,200 volt switch-board in said substation, in accordance with conditions of paragraph 12 hereof.

(b) For 22,000 volt high tension power, at any point or points on the Company's 22,000 volt line or lines to be selected by the Commission as being most suitable for connection to the line or lines built or to be built by the Commission. Said connection or connections to be made by means of open-air switches or other connections of suitable design, to be installed by the Commission, and all expense incident thereto is to be borne by the Commission. It being, however, understood and agreed that during the period of time required by the Commission to make such connection or connections the Company, upon ten days' notice in writing from the Commission, shall shut off the power from its high tension line or lines, and the Commission shall not be held liable for any claim or claims on the part of the Company or its customers, which might arise as a result of interrupted service during such above period. The Commission will arrange to make the final connections on Sunday whenever possible.

The power so taken shall be measured at the nearest stepdown transformer station of the Commission, in accordance with the conditions of paragraph 12 hereof.

7. This agreement shall remain in force for ten years from the date of the expiration of the said first notice or thirty days. The Commission may at its option continue this agreement for one or two further consecutive terms, the first of these two additional terms being of five years' duration, and the second of such length that the expiry thereof shall fall on the tenth day of September, 1929, being the date upon which the lease of the Company with the Crown will expire. The Commission may exercise the first of these options by first giving notice in writing of its intention to continue this agreement for the second term of five years, at least one year before the expiration of the first term of ten years, and if pursuant to such notice, this agreement is continued beyond the second term of five years, by giving notice in writing of its intention to continue this agreement until the said tenth day of September, 1929, at least one year before the expiration of the said second term of five years.

Duration of contract.

8. The electric power herein contracted for shall be three-phase, alternating, commercially continuous, twenty-four hour power every day of the year except as provided in paragraph 14 hereof.

Characteristics.

9. It is agreed that maintenance by the Company of the agreed voltage at the agreed frequency at the points of delivery, having regard to the distance of such points from the point of generation, shall constitute the delivery of all power involved herein and the fulfillment of all operating obligations hereunder, and that when voltage and fre-

Conditions of delivery.

quency are so maintained, the amount of power, its fluctuations, load factor, power factor, distribution as to phases, and all other electric characteristics and qualities are under the sole control of the Commission, its agents, customers, apparatus, appliance and circuits.

Power
factor.

10. The Commission shall so take power that the kilovolt-amperes so taken shall not at any time exceed by more than ten per cent. the kilowatts held in reserve for it and this provision shall apply proportionately to each circuit and phase.

When the kilovolt amperes of the measured power shall exceed by more than ten (10) per cent. the kilowatts held in reserve, and when, upon thirty (30) days' notice from the Company, the Commission fails to remedy such condition, the excess kilovolt-amperes shall be paid for as true power, but only while such condition exists. The Commission shall be notified by the Company whenever the above condition obtains.

Type of
plant and
regulation.

11. The Company shall at all times use first-class modern, standard, commercial Hydro-Electric power apparatus and plant, and the power shall be delivered at approximately 60 cycles per second, and at approximately 22,000 volts for high tension power, and at approximately 2,200 volts for low tension power, allowance being made for the distance of the points of delivery from the point of generation. The Company shall use first class, modern, standard, regulating apparatus and all due skill and diligence to maintain the power at such voltage and frequency. The maximum allowable variation at the power house under normal operating conditions shall be $2\frac{1}{2}$ per cent. above or below frequency and voltage herein specified. The Company shall use all due diligence to prevent greater variation than above provided for, caused by temporary abnormal conditions, and the Company shall not be in any way liable if such due diligence is used.

The Commission shall provide step-down transformers with taps to receive high tension power at 22,000, 21,000, 20,000 and 19,000 volts at high tension terminals in the transformer station of the Commission.

The Commission and its customers shall select and use transformers and all apparatus most suitable to receive the electric power produced by the apparatus of the Company, and the Commission's transmitting, transforming, translating and all other apparatus and devices upon its circuits when receiving power from the Company shall be of modern standard design and construction, and shall be operated and maintained with special reference to securing the highest efficiency and most perfect operation consistent with commercial practice, not only of its own, but also of the apparatus of the Company when receiving power from the Company; and the Commission shall install upon and equip all circuits with such modern and approved protective devices as are necessary to afford the same measure of protection provided by the Company for its own circuits.

Measurement
of power.

12. The power herein provided for shall be measured by curve drawing meters. The meters shall be subject to test as to accuracy by either party hereto and shall be furnished by and installed by the Com-

pany when required, in the transformer stations of the Commission, and in the transformer stations of the Company, and the Commission shall have the right to install instruments in said stations for checking the records made by the aforesaid instruments, and the Commission and the Company will provide suitable space in their respective stations, for the proper installation of duplicate sets of curve drawing meters, and such other measuring apparatus as the Commission may deem necessary.

When power is delivered to, and measured in, the Commission's transformer stations at a distance of more than five miles from the Company's high tension line, allowance shall be made for C²R loss between point of delivery and point of measurement.

13. The Engineers of the Commission or one or more of them or any other person or persons appointed for this purpose by the Commission, shall have the right from time to time during the continuance of the agreement to inspect the apparatus, plant and property of the Company and take records at all reasonable hours. If in the opinion of the Commission any such apparatus, devices, wiring, plant or property is defective or is liable to cause interruption or trouble to or in connection with the supply of the said power, then the Company shall forthwith on request by the Commission's Engineer make such changes at the expense of the Company as may be required by the said Engineer. In the event of non-compliance by the Company with any requirement of the Commission, under this paragraph, the Commission may, at its discretion, after notice has been given in writing, proceed to make such changes in accordance with the recommendation of said Engineer, and a sufficient sum to cover all costs in connection therewith shall be deducted from any moneys payable by the Commission to the Company under this agreement. Nothing contained in this paragraph shall limit or impair the rights of the Company to seek redress under paragraph 20 hereof.

Inspection
and
alterations.

14. In case the Company shall at any time be prevented from delivering said power, or any part thereof, or in case the Commission shall at any time be prevented from taking said power, or any part thereof, by strike, lockout riot, fire, invasion, explosion, act of God, or the King's enemies, or any other cause reasonably beyond their control, then the Company shall not be bound to deliver such power during such time and the Commission shall not be bound to pay for such power during such time, but as soon as the cause of such interruption is removed, the Company shall, without any delay, deliver the said power as aforesaid, and the Commission shall take the same and each of the parties hereto shall be prompt and diligent in removing and overcoming such causes of interruption.

Shut-downs.

15. In case the plant, apparatus, building or premises of the Company or any part thereof, shall at any time during the continuance of this agreement be damaged or destroyed so as to prevent the Company from supplying the said power of the quantity hereinbefore provided for to the Commission, the Company shall use its best endeavor to procure the said supply of power for the Commission otherwise or elsewhere, and if

Destruction
of plant.

the Company fails or neglects to procure such power for the Commission then the Commission may, with the approval of the Lieutenant-Governor-in-Council, procure such power at reasonable rates and charge the same to the Company; and if the said power cannot be procured either by the Company or the Commission then the Commission may, with the approval of the Lieutenant-Governor-in-Council, terminate this agreement.

**Precedence
of demand.**

16. After the happenings of any of the events provided for in paragraphs 14 and 15 hereof, power shall be delivered first for delivery to public utilities, whether the same are being supplied by the Commission or directly by the Company. Said delivery to be pro rata, first for waterworks service, second for lighting, and third for railway services, after which power shall be delivered pro rata to the Commission and other customers of the Company.

**Liquidated
damages.**

17. If and so often as any interruption shall occur in the service of the Company due to any cause or causes other than those provided for by paragraphs 14 and 15 hereof, the Company shall pay to the Commission as liquidated and ascertained damages, and not by way of penalty as follows:

For any interruption less than one hour double the amount payable for power which should have been delivered during the time of such interruption, and for any interruption of one hour or more, the amount payable for the power which should have been delivered during the time of such interruption, and six times the last mentioned amount in addition thereto, and all moneys payable under this paragraph, when the amount thereof is settled between the parties may be deducted from any moneys payable by the Commission to the Company under this agreement.

**Improvement
of service.**

18. It is recognized by both the parties hereto that the state of the art of production, transmission and application of electrical energy is subject to constant advance, and that it is impossible by contract to cover all the requirements and conditions which time may develop; the Company and the Commission with the approval of the Lieutenant-Governor-in-Council while adhering to the provisions of this agreement will at any time upon request of the other, take up and in good faith fairly consider, with the aid of the respective engineers, any features of changes of the system as a whole or any modifications of any of the provisions hereof provided, it shall appear to the party to whom such request is made that compliance therewith shall tend to make this agreement more effective and to make the venture of each party more successful and certain, provided however, that any such action or the failure on the part of either party to require of the exact conformity to the provisions of this agreement or any liberty or greater latitude beyond the provisions of this agreement allowed by either party to the other in course of the co-operation implied by the spirit of this agreement, shall in no manner operate as or constitute a precedent or amend or change the obligations of the parties thereto.

**Expropria-
tion.**

19. This agreement is entered into subject to the provisions of the Power Commission Act and neither the making of this agreement, nor

anything herein contained shall in any way limit or prejudice any rights and powers which the Commission may have to expropriate the plant and apparatus of the said Company, or any part thereof, or the power generated by the said Power Company or any other Power Company, but nothing in this agreement shall be taken to give or enlarge any such rights or power.

20. It is agreed that in case any dispute shall arise relating to the question of the performance and fulfillment of any of the terms, provisions or conditions of this agreement, or as to the method of accuracy of the measurement of the power, or as to any question which may arise under this agreement, or as to the rights of any of the parties after the termination of this agreement, under paragraph 21, the same shall be determined by two independent persons, one to be chosen by each of the parties of such dispute, and such persons before proceeding with the reference, shall appoint a third arbitrator to act with them, and the decision of the said three arbitrators or a majority of them, shall be conclusive on both parties, except as hereinafter provided and in case either of the said parties shall neglect or fail to appoint an arbitrator within thirty days after the request in writing by the other party then the arbitrator appointed by the other party may proceed alone and his award shall be conclusive on both parties except as hereinafter provided. The award shall be made within four months after the appointment of the first of such arbitrators, and in the event of the arbitrators appointed as aforesaid being unable or unwilling to agree upon a third arbitrator within two weeks after their appointment or the appointment of the one of them who was last appointed, then such third arbitrator shall be chosen and appointed by the Chief Justice for the time being of the King's Bench Division of the High Court of Justice for the Province of Ontario, or in the event of the said Chief Justice being ill, absent from the Province or otherwise unable or refusing to act, then such third arbitrator shall be appointed by any Judge of the High Court of Justice or any Judge other than a local Judge. It is agreed that there may be an appeal by either party from any decision or award of such arbitrators to the High Court of Justice of Ontario in accordance with the provisions of the Arbitration Act in that behalf.

21. If at any time that the quantity of power which is being taken under this agreement by the Commission shall amount to sixty per cent. or more of the total power which the Company is developing, and a complaint is then made in writing by the Commission to the Company that the Company has so continuously neglected or failed to perform the terms of this agreement that the apparatus of the Commission or its customers cannot, by reason of such neglect or failure of the Company, be operated to full efficiency, and the Company shall not within a reasonable time remedy such neglect or failure, then the matter of complaint may be referred to the Lieutenant-Governor-in-Council, and if he determine that there is a just ground for complaint, he may direct that the Council shall, within a time to be fixed by him, remedy such neglect or failure and if such neglect or failure be not remedied as directed by him, the

Arbitration.

Inefficient service.

Lieutenant-Governor-in-Council may order that upon such terms as he may deem reasonable, including the rights of other parties interested, the whole of the plant, apparatus and property of the Company, shall be transferred to the Commission whereupon on payment and satisfaction of the said terms, the amount of which payment and satisfaction is to be settled by the arbitrators appointed as hereinbefore stated, the Commission may, with the approval of the Lieutenant-Governor-in-Council, take over the plant, apparatus and property of the Company, and the same shall be transferred to the Commission.

**Damage
suits.**

22. In case any municipal corporation which shall contract with the Commission for a supply of power or any person, firm or corporation, which shall contract with any such municipal corporation, or with the Commission for a supply of power furnished to the Commission by the Company, shall suffer damages by the act or neglect of the Company, and such municipal corporation, person, firm or corporation would, if the Company had made this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of such municipal corporation, person, firm or corporation, and notwithstanding any acts, decision or rule of law to the contrary the Commission shall be entitled to all the rights and remedies of such municipal corporations, person, firm or corporation, including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation, person, firm or corporation shall have agreed with the Commission to pay any costs that may be adjudged to be paid if such proceeding or action is unsuccessful. The rights and remedies of any such municipal corporation, person, firm or corporation shall not be hereby prejudiced.

**Continuous
delivery.**

23. Subject to the provisions of paragraph 15 and 21 of this agreement, notwithstanding there may be differences between the parties hereto as to the supply or sufficiency of the said power, or the payment therefor; or any other questions whatsoever which may arise under this agreement the Company shall continue to deliver the power and the Commission to pay therefor, and both parties shall continue to carry out the contract notwithstanding such differences; and when the matters which may be so in issue shall be finally determined by the reference to arbitration in the manner provided by paragraph 20 hereof, the parties shall deal with such matters according to the terms of the award which may be made upon such reference. It being the distinct agreement between the parties that there shall not be during the period of this agreement any stoppage or cessation in the supply of the said power for the payments therefor, but that the same shall be continued as if there was no such difference.

Restrictions.

24. During the period of this agreement, or extension thereof, the Company shall not directly or indirectly supply power to any municipality, or to any person, firm or corporation therein, while such person,

firm or corporation therein is supplied by the Commission, nor shall the Commission purchase or supply power from any other source than the Company within a distance of five (5) miles of the Company's transmission line as at this date existing, except in the event of the Company not having power available to meet the requirements of the notice of the Commission.

25. Notwithstanding anything hereinbefore contained this agreement shall not come into operation as against the Commission or be binding upon the Commission until in addition to any other Order-in-Council, pursuant to said Act, an Order-in-Council has been passed and approved by the Lieutenant-Governor-in-Council, expressly declaring that this agreement shall from the date of such Order-in-Council be binding upon the Commission, but this shall in no way interfere with the agreement contained in paragraph 3 (a) and the Commission undertakes to do all things lawful in its power that may be needed to bring this agreement into operation at as early a date as possible, and to procure the assent and declaration of the said Lieutenant-Governor-in-Council above referred to, and the said Company agrees to co-operate with the Commission by all means in its power to carry out the object of this agreement.

26. Notwithstanding anything herein contained to the contrary, it is hereby distinctly understood and agreed that the rights, privileges or powers of either party under the Acts, Chap. 145, o. s. 9 (Edward VII.) and Chapter 151, o. s. 10 (Edward VII.) and amendments thereof, or Lease number 1,815, as issued to the Company by the department of Crown Lands bearing date of the 7th day of September, 1909, shall be in no way impaired, prejudiced or varied and same in all respects shall remain in full force and effect as if this agreement had not been made.

27. This agreement shall extend to, and be binding upon and enure to the benefit of the successors and assigns of the parties hereto.

IN WITNESS WHEREOF the Commission and the Company have respectively affixed their corporate seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

[SEAL.]

HYDRO-ELECTRIC POWER
COMMISSION.

(Sgd.) A. BECK, *Chairman.*

(Sgd.) W. W. POPE,
Secretary.

THE SIMCOE RAILWAY &
POWER COMPANY.

(Sgd.) W. J. LOVERING,
President.

(Sgd.) W. FINLAYSON, *Vice-
President and Secretary.*

THIS INDENTURE made in duplicate this twentieth day of July in the year of our Lord one Thousand Nine Hundred and Eleven.

BETWEEN

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter called the "Commission."

party of the First Part.

and

THE MUNICIPAL CORPORATION OF THE TOWN OF MIDLAND, hereinafter called the "Corporation."

party of the Second Part.

WHEREAS, pursuant to "An Act to provide for transmission of electrical power to Municipalities" the Corporation applied to the Commission for a supply of power, and the Commission have entered into a contract with the Simcoe Railway and Power Co., and the electors of the Corporation assented to a by-law authorizing the Corporation to enter into a contract with the Commission for such power.

1. NOW THEREFORE THIS INDENTURE WITNESSETH that in consideration of the premises and of the agreements of the corporation herein set forth, subject to the provisions of said Act and of the said contract, the Commission agrees with the Corporation:

(a) At the expiration of thirty days' notice in writing from the Corporation to the Commission, to reserve and deliver when called for 200 h.p. or more of electric power to the Corporation. Said notice shall be given not later than June 15th, 1911.

(b) At the expiration of thirty days' notice in writing which may be given by the Corporation from time to time, during the continuance of this agreement, to reserve and deliver to the Corporation additional electric power when called for in blocks of 50 h.p. each until 500 h.p. is being delivered or is reserved by the Power Company, and then in blocks of 100 h.p. each until the total amount so reserved or delivered shall amount to 1,600 h.p.

(c) To use at all times first-class, modern, standard commercial apparatus and plant, and to exercise all due skill and diligence so as to secure the satisfactory operation of the plant and apparatus of the Corporation.

(d) The power shall be delivered to the Corporation at approximately 2,200 volts and at approximately 60 cycles per second.

2. In consideration of the premises and of the agreements herein set forth, the Corporation agrees with the Commission:

(a) To use all diligence by every lawful means in its power to prepare for the receipt and use of the power dealt with by this agreement so as to be able to give notice as specified in paragraph 1 (a).

(b) Subject to the provisions of paragraph 2 (e) hereof, to pay the Commission the following prices: \$21.00 per h.p. per annum for all power reserved or taken until the demands of the Commission on the Power Company shall equal or exceed 500 h.p.

When the demand of the Commission on the Power Company shall have increased to 500 h.p. to pay \$20.00 per h.p. per annum for all or any proportion thereof reserved or taken by the Corporation.

When the demand of the Commission on the Power Company shall have increased to 1,000 h.p. to pay \$19.00 per h.p. per annum for all or any proportion thereof reserved or taken by the Corporation.

When the demand of the Commission on the Power Company shall have increased to 1,500 h.p. to pay \$17.50 per h.p. per annum for all or any proportion thereof reserved or taken by the Corporation.

Nothing herein contained shall bind the Commission to supply power on the demand of the Corporation after the demand of the Commission on the Power Company exceeds 1,600 h.p., unless the Power Company has power available or capable of development.

(c) The power shall be paid for in twelve monthly payments, in gold coin of the present standard of weight and fineness, at the office of the Commission at Toronto, and bills shall be rendered by the Commission on or before the 5th day and paid by the Corporation on or before the 15th day of each month. If any bill remains unpaid for fifteen days, the Commission may, in addition to all other remedies and without notice, discontinue the supply of power to the Corporation until said bill is paid. No such discontinuance shall relieve the Corporation from the performance of the covenants, provisoes and conditions herein contained. All payments in arrears shall bear interest at the legal rate.

(d) To take electric power exclusively from the Commission during the continuance of this agreement.

(e) To pay for three-fourths of the power ordered from time to time by the Corporation and held in reserve for it as herein provided whether it takes the same or not. When the greatest amount of power taken for any twenty consecutive minutes during any month shall exceed during the twenty consecutive minutes three-fourths of the amount ordered by the Corporation and held in reserve, then the Corporation shall pay for this greater amount during the entire month.

If the Corporation during any month takes more than the amount of power ordered and held in reserve for it for twenty consecutive minutes, the Corporation shall pay for this greater amount of power during the entire month. The taking of such excess shall thereafter constitute an obligation on the part of the Corporation to pay for and on the part of the Commission to hold in reserve an additional block of power in accordance with the terms and conditions of this contract.

When the power factor of the greatest amount of power taken for said twenty consecutive minutes falls below 90 per cent., the Corporation shall pay for 90 per cent. of said power divided by the Power factor.

(f) To use at all times, first-class, modern, standard commercial apparatus and plant to be approved by the Commission.

(g) To exercise all due skill and diligence so as to secure the most perfect operation of the plant and apparatus of the Commission and the Corporation.

3. This agreement shall remain in force for ten years from the date of the expiration of the said first notice of 30 days. The Corporation may, at its option, continue this agreement for one or two further consecutive terms, the first of these two additional terms being of five years' duration, and the second of such length that the expiry thereof shall fall on the 10th day of September, 1929.

(a) Provided, however, that in the event of the Commission being in a position to furnish power either by a further agreement with the Simcoe Railway and Power Company or otherwise, the Corporation may, at its option, continue this agreement for a further term of twelve years' duration.

(b) The Corporation may exercise the first of these options by giving notice in writing of its intention to continue this agreement for the second term of five years at least two years before the expiration of the first term of ten years.

(c) The Corporation may exercise the second of these options by giving notice in writing of its intention to continue this agreement for the third term until the expiry date on September 10th, 1929, at least two years before the expiration of the second term of five years.

(d) The Corporation may, subject to the conditions set out in paragraph 3 (a) exercise the further option therein mentioned by giving the Commission notice in writing of its intention to continue this agreement for the further term of twelve years at least two years before the expiration of the term falling on the 10th day of September, 1929.

4. The power shall be approximately 2,200 volts, 60 cycle, 3 phase, alternating commercially continuous twenty-four hour power every day in the year except as provided herewith, and shall be delivered by the Commission to the Corporation at the low tension outlet bushings of the Sub-Station of the Simcoe Railway and Power Company, at the outskirts of the Town of Midland.

(a) The Power so taken shall be measured at the 2,200 volt switchboard in said sub-station by Graphic Recording Curve Drawing Meters, subject to test as to accuracy by either party hereto.

(b) The maintenance by the Commission of approximately the agreed voltage at approximately the agreed frequency at the Sub-station in the limits of the Corporation shall constitute the supply of all power involved herein and the fulfilment of all operating obligations hereunder; and when the voltage and frequency are so maintained, the amount of the power, its fluctuations, load factor, power factor, distribu-

tion as to phases, and all other electric characteristics and qualities are under the sole control of the Corporation, their agents, customers, apparatus, appliances and circuits.

5. The Engineers of the Commission, or one or more of them, or any other person or persons appointed for this purpose by the Commission, shall have the right from time to time during the continuance of this agreement to inspect the apparatus, plant and property of the Corporation and take records at all reasonable hours.

6. In case the Commission should at any time or times be prevented from supplying said power, or any part thereof, or in case the Corporation shall at any time be prevented from taking said power, or any part thereof, by strike, lockout, fire, invasion, explosion, act of God, or the King's enemies, or any other cause reasonably beyond their control then the Commission shall not be bound to deliver such power during such times, and the Corporation shall not be bound to pay the price of said power during such time, but as soon as the cause of such interruption is removed, the Commission shall without any delay supply said power as aforesaid, and the Corporation shall take the same and shall be prompt and diligent in removing and overcoming such cause or causes of interruption.

7. If, and so often as any interruption shall occur in the service of the Power Company due to any cause or causes, other than those provided for by the next preceding paragraph hereof, the Commission shall recover and pay to the Corporation as liquidated and ascertained damages, and not by way of penalty, as follows: For any interruption of less than one hour double the amount payable for power which should have been supplied during the time of such interruption, and six times the last mentioned amount in addition thereto, and all moneys payable under this paragraph, when the amount thereof is settled between the Commission and the Company, may be deducted from any money payable by the Corporation to the Commission, but such right of deduction shall not in any case delay the said monthly payments.

8. If at any time any other Municipal Corporation or pursuant to said Act, any railway or distributing company, or any other Corporation or person, applies to the Commission for a supply of power, the Commission shall notify the applicant and the Corporation in writing, of a time and place and hear all representations that may be made as to terms and conditions for such supply.

Without discrimination in favor of the applicants as to the price to be paid, for equal quantity of power, the Commission may supply power upon such terms and conditions as may, having regard to the risk and expense incurred, and paid, and to be paid by the Corporation, appear equitable to the Commission, and are approved by the Lieutenant Governor-in-Council.

No such application shall be granted if the said line is not adequate for such supply or if the supply of the Corporation will be thereby injuriously affected, and no power shall be supplied within the limits of a Municipal Corporation taking power from the Commission at the time of such application without the written consent of such Corporation.

In determining the quantity of power supplied to a Municipal Corporation, the quantity supplied by the Commission within the limits of the Corporation to any applicant, other than a Municipal Corporation, shall be computed as part of the quantity supplied to such corporation, but such Corporation shall not be liable to pay for the power so supplied, or otherwise in respect thereof. In order to prevent discrimination by the Municipal Corporation, no power shall be supplied by the Municipal Corporation to any railway or distributing company without the written consent of the Commission, but the Corporation may sell power to any person or persons or manufacturing companies inside the limits of the Town of Midland, but such power shall not be sold for less than the cost and without discrimination as regards price and quantity.

9. In case any Municipal Corporation, or any person, firm or Corporation which shall contract with the Commission or with any Municipal Corporation for a supply of power furnished to the Commission by the Power Company shall suffer damages by the act or neglect of the Power Company, and such Municipal Corporation, person, firm or Corporation would, if the Power Company had made the said contracts directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of such Municipal Corporation, person, firm, or Corporation, and notwithstanding any act, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such Municipal Corporation, person, firm or Corporation, including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation, person, firm or corporation shall have agreed with the Commission to pay any costs that may be adjudged to be paid if such proceedings or action is unsuccessful. The rights and remedies of any such municipal corporation, person, firm, or corporation shall not be hereby prejudiced.

10. If differences arise between Corporations to whom the Commission is supplying power, the Commission may upon application fix a time and place to hear all representations that may be made by the parties and the Commission shall, in a summary manner, when possible, adjust such differences, and such adjustment shall be final. The Commission shall have all the powers that may be conferred upon a Commissioner appointed under the Act respecting Enquiries concerning Public Matters.

11. If differences arise between the Corporation and the Commission, the Lieutenant Governor-in-Council may, upon application, fix a time and place to hear all representations that may be made by the parties, and the Lieutenant Governor-in-Council shall, in a summary manner, when possible, adjust such differences and such adjustment shall be final. The Lieutenant Governor-in-Council shall have all the powers that may be conferred upon a Commissioner appointed under the Act respecting enquiries concerning public matter.

12. This agreement shall extend to and be binding upon and enure to the benefit of the successors and assigns of the parties hereto.

IN WITNESS WHEREOF the Commission and the Corporation have respectively affixed their corporate seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

[SEAL.]

{ HYDRO-ELECTRIC POWER
COMMISSION.

(Sgd.) A. BECK, *Chairman.*

(Sgd.) W. K. McNAUGHT,

{ CORPORATION OF TOWN OF
MIDLAND.

(Sgd.) DIGBY HARELL, *Mayor.*

(Sgd.) FRANK R. WESTON,
Clerk.

THIS INDENTURE made in duplicate this second day of May, in the year of our Lord One Thousand Nine Hundred and Eleven.

BETWEEN :

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO hereinafter called the "Commission,"

party of the First Part.

and

THE MUNICIPAL CORPORATION OF THE TOWN OF PENETANGUISHENE hereinafter called the "Corporation,"

party of the Second Part.

Whereas, pursuant to "An Act to provide for transmission electrical power to municipalities," the Corporation applied to the Commission for a supply of power, and the Commission have entered into a contract with the Simcoe Railway and Power Co., and the electors of the Corporation assented to a by-law authorizing the Corporation to enter into a contract with the Commission for such power.

1. NOW THEREFORE THIS INDENTURE WITNESSETH, that in consideration of the promises and of the agreements of the Corporation herein set forth, subject to the provisions of said Act and of the said contract, the Commission agrees with the Corporation:

(a) To reserve and deliver at the earliest possible date 200 h.p. or more of electric power to the Corporation.

(b) At the expiration of thirty days' notice in writing which may be given by the Corporation from time to time, during the continuance of this agreement, to reserve and deliver to the Corporation additional electric power when called for in blocks of 50 h.p. each until 500 is being delivered or reserved, and then in blocks of 100 h.p. each until the total amount so reserved or delivered shall amount to 1,600 h.p.

(c) To use at all times first-class, modern, standard commercial apparatus and plant, and to exercise all due skill and diligence so as to secure satisfactory operation of the plant and apparatus of the Corporation.

(d) The power shall be delivered to the Corporation at approximately 2,200 volts and at approximately 60 cycles per second.

2. In consideration of the premises and of the agreement herein set forth, the Corporation agrees with the Commission:—

(a) To use all diligence by every lawful means in its power to prepare for the receipt and use of the power dealt with by this agreement so as to be able to receive power when the Commission is ready to deliver the same.

(b) Subject to the provisions of paragraph 2 (f) hereof to pay the Commission the following prices: \$20.00 per h.p. per annum for all power taken until the demands of the Commission on the Power Company shall equal or exceed 500 h.p.

When the demand of the Commission on the Power Company shall equal or exceed 500 h.p. to pay \$19.00 per h.p. per annum for all or any proportion thereof taken by the Corporation.

When the demand of the Commission on the Power Company shall have increased to 1,000 h.p. to pay \$18.50 per h.p. per annum for all or any proportion thereof taken by the Corporation.

Nothing herein contained shall bind the Commission to supply power on the demand of the Corporation after the demand of the Commission on the Power Company exceeds 1,600 h.p., unless the Power Company has power available or capable of development.

(c) To pay in addition annually, interest at 4 per cent. per annum upon the moneys expended by the Commission on capital account for the construction of the transmission lines from the Midland Station of the Simcoe Railway and Power Co., the transformer station and equipment in Penetanguishene, and other necessary works required for the delivery of power, and transforming it from 22,000 to 2,200 volts.

Also to pay an annual part of the cost of the construction of the said line, station and works so as to form in thirty (30) years a sinking fund for the payment of the moneys advanced by the Province of Ontario, in connection with this work.

Also to pay the cost of operating, maintaining, repairing, renewing, and insuring the said line, station and works.

(d) The amounts payable under this contract shall be paid in twelve monthly payments in gold coin of the present standard of weight and fineness, at the office of the Commission at Toronto, and Bills shall be rendered by the Commission on or before the 5th day and paid by the Corporation on or before the 15th day of each month. If any Bill remains unpaid for fifteen days, the Commission may, in addition to all

other remedies and without notice, discontinue the supply of power to the Corporation until said bill is paid. No such discontinuance shall relieve the Corporation from the performance of the covenants, provisions and conditions herein contained. All payments in arrears shall bear interest at the legal rate.

(e) To take electric power exclusively from the Commission during the continuance of this agreement.

(f) To pay for three-fourths of the power ordered from time to time by the Corporation and held in reserve for it as herein provided whether it takes the same or not. When the greatest amount of power taken for any twenty consecutive minutes during any month shall exceed during the twenty consecutive minutes three-fourths of the amount ordered by the Corporation and held in reserve, then the Corporation shall pay for this greater amount during the entire month.

If the Corporation during any month takes more than the amount of power ordered and held in reserve for it for twenty consecutive minutes, the taking of such excess shall thereafter constitute an obligation on the part of the Corporation to pay for and on the part of the Commission to hold in reserve an additional block of power in accordance with the terms and conditions of this contract.

When the power factor of the greatest amount of power taken for said twenty consecutive minutes falls below 90 per cent., the Corporation shall pay 90 per cent. of said power divided by the power factor.

(g) To use at all times first-class modern, standard commercial apparatus and plant, approved by the Commission.

(h) To exercise all due skill and diligence so as to secure satisfactory operation of the plant and apparatus of the Commission and the Corporation.

3. This agreement shall remain in force for ten years from the date of the expiration of the said first notice of 30 days. The Corporation may, at its option, continue this agreement for one or two further consecutive terms, the first of these two additional terms being of five years' duration, and the second of such length that the expiry thereof shall fall on the 10th day of September, 1929.

(a) Provided, however, that in the event of the Commission being in a position to furnish power either by a further agreement with the Simcoe Railway and Power Company or otherwise, the Corporation may, at its option, continue this agreement for a further term of twelve years' duration.

(b) The Corporation may exercise the first of these options by giving notice in writing of its intention to continue this agreement for the second term of five years at least two years before the expiration of the first term of ten years.

(c) The Corporation may exercise the second of these options by giving notice to the Commission in writing of its intention to continue this agreement for the third term until the expiry date on September 10th, 1929, at least two years before the expiration of the second term of five years.

(d) The Corporation may, subject to the conditions set out in paragraph 3 exercise the further option herein mentioned by giving the Commission notice in writing of its intention to continue this agreement for the further term of twelve years at least two years before the expiration of the term falling on the 10th day of September, 1929.

4. The power shall be approximately 2,200 volts, 60 cycle, 3 phase, alternating commercially continuous twenty-four hour power every day in the year except as provided herewith and shall be delivered by the Commission to the Corporation at the 2,200 volt terminals of the step-down transformers in the sub-station in the Corporation Limits.

(a) That the meters with their series or potential transformers may be connected to the high tension side or low tension side of the transformers, or some connected to one side and some connected to the other, as the Commission may elect. That whenever connected at other than the point of measurement their readings shall be subject to a correction and shall be corrected to give a reading such as would be obtained by instruments as if connected at the point of measurement. That such corrections shall be based upon tests made upon the step-down transformers and transmission lines by the Commission, or any other tests upon them acceptable to the Commission as to the efficiency, regulation, or any other constants of the transformers and transmission lines necessary for said correction, but that such tests, when made by the Commission, are to be made in the presence of the representative or representatives of the Customer if it so desires.

(b) The maintenance by the Commission of approximately the agreed voltage at approximately the agreed frequency at the sub-station in the limits of the Corporation shall constitute the supply of all power involved herein and the fulfilment of all operating obligations hereunder; and when voltage and frequency are so maintained, the amount of the power, its fluctuations, load factor, power factor, distribution as to phases and all other electric characteristics and qualities are under the sole control of the Corporation their guests, customers, apparatus, appliances and circuits.

5. The engineers of the Commission, or one or more of them, or any other person or persons appointed for this purpose by the Commission, shall have the right from time to time during the continuance of this agreement to inspect the apparatus, plant and property of the Corporation and take records at all reasonable hours.

6. In case the Commission should at any time or times be prevented from supplying said power, or any part thereof, or in case the

Corporation shall at any time be prevented from taking said power, or any part thereof, by strike, lock-out, fire, invasion, explosion, act of God, or the King's enemies, or any other cause reasonably beyond their control, then the Commission shall not be bound to deliver such power during such times, and the Corporation shall not be bound to pay the price of said power during such time, but as soon as the cause of such interruption is removed, the Commission shall without any delay supply said power as aforesaid, and the Corporation shall take the same and shall be prompt and diligent in removing and overcoming such cause or causes of interruption.

7. If, and so often as, any interruption shall occur in the service of the Power Company due to any cause or causes, other than those provided for by the next preceding paragraph hereof, the Commission shall recover and pay to the Corporation as liquidated and ascertained damages, and not by way of penalty, as follows:—For any interruption of less than one hour double the amount payable for power which should have been supplied during the time of such interruption; and for any interruption of one hour or more the amount payable for the power which should have been delivered during the time of such interruption, and six times the last mentioned amount in addition thereto, and all moneys payable under this paragraph, when the amount thereof is settled between the Commission and the Company, may be deducted from any money payable by the Corporation to the Commission, but such right of deduction shall not in any case delay the said monthly payments.

8. If at any other time any other Municipal Corporation or pursuant to said Act, any Railway or distributing company, or any other Corporation or person, applies to the Commission for a supply of power, the Commission shall notify the applicant and the Corporation in writing, of a time and place and hear all representations that may be made as to the terms and conditions for such supply.

Without discriminating in favor of the applicants as to the price to be paid, for equal quantity of power, the Commission may supply power upon such terms and conditions as may, having regard to the risk and expense incurred, and paid, and to be paid by the Corporation, and are approved by the Lieutenant-Governor-in-Council.

No such application shall be granted if the said line is not adequate for such supply, or if the supply of the Corporation will be thereby injuriously affected, and no power shall be supplied within the limits of a Municipal Corporation taking power from the Commission at the time of such application without the written consent of such Corporation.

In determining the quantity of power supplied to a Municipal Corporation, the quantity supplied by the Commission within the limits of the Corporation to any applicant, other than a Municipal Corporation, shall be computed as part of the quantity supplied to such Corporation, but such Corporation shall not be liable to pay for the power so supplied, or otherwise in respect thereof. In order to prevent discrimination by the Municipal Corporation, no power shall be supplied by the Municipal Corporation to any railway or distributing company without the written

consent* of the Commission, but the Corporation may sell power to any person or persons or manufacturing companies inside the limits of the Corporation, but such power shall not be sold for less than the cost and without discrimination as regards price and quantity.

9. In case any Municipal Corporation, or any person, firm or Corporation which shall contract with the Commission or with any Municipal Corporation for a supply of power furnished to the Commission by the Power Company shall suffer damages by the act or neglect of the Power Company, and such Municipal Corporation, person, firm or Corporation would, if the Power Company had made the said contracts directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of such Municipal Corporation, person, firm, or Corporation, and notwithstanding any Acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such Municipal Corporation, person, firm or Corporation, including the right to recover such damages, but no action shall be brought by the Commission until such Municipal Corporation, person, firm or Corporation shall have agreed with the Commission to pay any costs that may be adjudged to be paid if such proceedings or action is unsuccessful. The rights and remedies of any such municipal corporation, person, firm or corporation shall not be hereby prejudiced.

10. If differences arise between Corporations to whom the Commission is supplying power, the Commission may upon application fix a time and place to hear all representations that may be made by the parties and the Commission shall, in a summary manner when possible, adjust such differences and such adjustment shall be final. The Commission shall have all the powers that may be conferred upon a Commissioner appointed under the Act respecting Enquiries concerning public matters.

11. If differences arise between the Corporation and the Commission, the Lieutenant-Governor-in-Council may, upon application, fix a time and place to hear all representations that may be made by the parties, and the Lieutenant-Governor-in-Council shall, in a summary manner, when possible, adjust such differences and such adjustment shall be final. The Lieutenant-Governor-in-Council shall have all the powers that may be conferred upon a Commissioner appointed under the Act respecting Enquiries concerning public matters.

12. This agreement shall extend to, be binding upon and enure to the benefit of the successors and assigns of the parties hereto.

IN WITNESS WHEREOF the Commission and the Corporation have respectively allixed their corporate seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

[SEAL.]

{ HYDRO-ELECTRIC POWER
COMMISSION.

(Sgd.) A. BECK, *Chairman.*

(Sgd.) J. S. HENDRIE.

{ CORPORATION OF TOWN OF
PENETANGUISHENE.

(Sgd.) J. A. JENNINGS, *Mayor.*

W. H. HEWSON, *Town Clerk.*

THIS AGREEMENT dated the Nineteenth Day of September, A.D. 1911.

BETWEEN—

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
herein called the “Commission” the First Party,

— and —

THE DOMINION SEWER PIPE CO., LIMITED, herein called
the “Customer” the Second Party.

WITNESSETH:

1. The Commission agrees with the Customer to deliver as soon as possible after September 15th, 1911, 200 horse power of electrical power to the Customer at the terminals of the step-down transformers located on the Customer's premises south of Waterdown, in the Township of East Flamboro, Concession 1, Lot 3.

2. The Customer agrees with the Commission:

(a) To take power exclusively from the Commission for ten years from the date such is available for their use and not to sell or dispose of the said power, or any part thereof, directly or indirectly, without the written consent of the Commission. If as therein provided the contracts with the Ontario Power Company are continued until 19th December, 1939, the Customer shall be entitled to renew this agreement for a further consecutive term of ten years by giving three months' previous notice in writing of intention to renew.

(b) To contract for 200 horse power and to pay each month for the greatest amount of power taken for any 1½ consecutive minutes during that month, at the rate of \$32.50 per H.P. per annum, and to commence such payments within one month from the date of written notice from the Commission that power is available for use.

(c) To pay each month as a minimum for 75 per cent. of the amount of power contracted for or held in reserve.

(d) At all times to take and use the three phase power in such a manner that the current will be equally taken from the three phases, and in no case shall the difference between any two phases be greater than three per cent. The Customer shall at all times take and use three phase power in such a manner that the power factor will be as near one hundred per cent. as possible. Whenever it is not possible to take current at 100 per cent. P.F. and the power factor of the greatest amount of power taken for said one and one-half minutes is less than 90 per cent., the Customer shall pay for 90 per cent. of the said power divided by the power factor.

(e) The Customer shall furnish sufficient and proper space in his transformer station or some other suitable building for the installation of the Protective, Control and transforming equipment necessary to protect, step down and control the power delivered, and shall operate this equipment under the instructions of the Commission. The Customer shall also provide the right-of-way for the transmission line selected by the Commission across property owned by the Customer and keep the same clear of all buildings, trees, brush, etc., for a distance of one rod on either side of the centre line during the continuance of this contract. The Commission shall have the right to inspect and repair apparatus.

(f) The Commission shall be entitled, at the termination of this agreement to remove all the Commission's plant and equipment on the Customer's premises including transformers, protective and control equipment.

3. It is further agreed:—

(a) If at any time the Customer's demand for power exceeds the amount held in reserve or an amount greater than that then permissible by the terms of this agreement, the amount held in reserve shall thereby be automatically increased by an amount equal to such excess above the specified or permissible amount held in reserve, and such increased amount shall thereafter be purchased and paid for until a greater amount shall be taken in accordance with terms of this contract, or by, or on account of another demand for power above that permissible by the terms of this contract.

(b) Payments shall be made in gold coin of the present standard of weight and fineness, and bills shall be rendered by the Commission on or before the first and paid by the Customer on or before the fifteenth of each month. If any bill remains unpaid for fifteen days, the Commission may, in addition to all other remedies and without notice, discontinue the supply of such power to the Customer in default until such bill is paid. No such discontinuance shall relieve the Customer in default from the performance of the covenants, provisoes and conditions herein contained. All payments in arrears shall bear interest at the legal rate.

(c) Said power shall be three phase, alternating at a periodicity of approximately 25 cycles, and at approximately 2,300 volts, and shall be commercially continuous 24 hour power every day of the year except as provided for hereunder.

The maintenance by the Commission of approximately the agreed voltage, at approximately the agreed frequency at the 2,300 volt terminals of the step down transformers at the point of delivery, shall constitute a supply of all power involved herein, and the fulfilment of all the operating obligations hereunder, and when the voltage and frequency are so maintained, the amount of power, its fluctuations, load factor, power factor, distribution as to phases and all other characteristics and qualities are under the sole control of the Customer, his agents, apparatus, appliances and circuits.

(d) The step down transformers and controlling apparatus shall be furnished, kept and maintained in good order by the Commission and the Customer shall select and use transformers and apparatus suitable to receive the electric power produced by the apparatus of the Commission. Also the Customer's transmitting, transforming, translating, and wherever possible all other apparatus and devices upon his circuits shall be first-class, modern, standard design and construction in commercial use and shall be operated and maintained with special reference to securing high efficiency and good operation, not only of its own, but also of the apparatus of the Customer when receiving power from the Commission; and the Customer shall install upon and equip his circuits with such approved protective devices as are in commercial use and operate its circuits in such a manner as will to the then greatest extent protect the apparatus and circuits of the Commission, and its own apparatus and circuits from damage and interruption from lightning, short circuiting and otherwise; all apparatus, machinery, and wiring to be approved of by the Commission.

(e) The Commission agrees to sell to the Customer at any time during the continuance of this contract the transformer and step down equipment installed in the Customer's buildings by the Commission. The price to be paid for this apparatus will be the capital cost less any amount set by for sinking fund and depreciation that has not been required for repairs or renewals.

(f) In case the Commission shall be prevented from delivering said electric power for one-half hour continuously, or in case the Customer shall be prevented from receiving said electric power for one-half hour continuously, by strike, riot, fire, lightning, invasion, explosion, act of God or the public enemies, or any other cause reasonably beyond the control, then the Customer shall not be liable to pay for such power during such period, but nothing herein contained shall be construed as permitting the Commission to refuse to deliver power or the Customer to refuse to receive the same as soon as the cause of interruption is removed, and each of the parties hereto shall be prompt and diligent in removing and overcoming such cause or causes.

(g) The Commission may at any time between the hours of one o'clock and five o'clock a.m. on any one day in the month, during the term of this contract, suspend the delivery of electric power under this contract, for the purpose of making repairs upon or improvements in any part of its transmission or distributing system, provided, however, that the Commission shall in every case give to the Customer such reasonable notice thereof as circumstances will permit. Deduction in this case shall be in accordance with 3 (e). If however, by prearrangement with, and consent of the Customer, the delivery of electric power should be suspended for the above purposes for more than one day above provided for, or at any other hours than those specified, deduction for such additional time or times shall be in accordance with 3 (e).

(h) In case any Municipal Corporation or any person, firm or corporation, which shall contract with any such Municipal Corporation, or with the Commission for a supply of power, shall suffer damages by the act or neglect of the Customer, and such Municipal Corporation, person, firm or corporation, would, if the Customer had made this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of such Municipal Corporation, person, firm or corporation, and notwithstanding any Acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such Municipal Corporation, person, firm or corporation, including the right to recover such damages, but no action shall be brought by the Commission until such Municipal Corporation, person, firm or Corporation shall have agreed with the Commission to pay any costs that may be adjudged to be paid if such proceeding or action is unsuccessful. The rights and remedies of any such Municipal Corporation, person, firm or corporation shall not be hereby prejudiced. The customer to be held responsible for any injuries or damages to persons sustained in the operation of the said equipment, and shall indemnify and save harmless the Commission from all such damage.

(i) This agreement shall extend to, and be binding upon and enure to the benefit of the successors and assigns of the parties hereto respectively.

IN WITNESS WHEREOF the parties hereto have affixed their seals, and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

{ THE DOMINION SEWER PIPE
COMPANY, LIMITED.

{ (Sgd.) A. M. DENOVA, *Vice-President*.
(Sgd.) F. K. WALLIS, *Secretary*.

{ HYDRO-ELECTRIC POWER
COMMISSION.

[SEAL.]

{ (Sgd.) A. BECK, *Chairman*.

{ (Sgd.) W. W. POPE,
Secretary.

THIS AGREEMENT made this Sixteenth Day of October, A.D. 1911.

BETWEEN—

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, herein called the “Commission” Party of the First Party,

— and —

THE STANDARD WHITE LIME COMPANY, LIMITED.
herein called the “Company,” Party of the Second Part.

WITNESSETH:

1. The Commission agrees with the Customer to deliver as soon as possible after October 15th, 1911, fifty (50) horse power of electrical power to the Customer at the terminals of the step-down transformers located on the Customer's premises, Lot Concession in the Township of North Oxford, County of Oxford, in the Province of Ontario.

2. The Customer agrees with the Commission:

(a) To take power exclusively from the Commission for ten years from the date hereof and not to sell or dispose of said power or any part thereof directly or indirectly without the written consent of the Commission. If as therein provided the contracts with the Ontario Power Company and the Commission are continued until 19th of December, A.D. 1919, the Customer shall be entitled to renew this agreement for a further consecutive term of ten years by giving the Commission three months' previous notice in writing of their intention to renew.

(b) To contract for fifty (50) horse power of electrical power and to pay each month for the greatest amount of power taken for any one (1) minute during that month at the rate of thirty-nine dollars and fifty cents (\$39.50) per horse power per annum, and to commence such payments within one month from the date of the receipt of written notice from the Commission that power is available for use.

(c) To pay each month as a minimum of 75 per cent. of the amount of power contracted for or held in reserve.

(d) At all times to take and use the three-phase power in such a manner that the current will be equally taken from the three phases, and in no case shall the difference between the two phases be greater than three per cent. The Customer shall at all times take and use three phase power in such a manner that the power factor will be as near one hundred per cent. as possible. Wherever it is not possible to take current at 100 per cent. P.F. and the power factor of the greatest amount of power taken for said one minute is less than 90 per cent., the Customer shall pay for 90 per cent. of the said power divided by the power factor.

(e) The power shall be measured at the point of delivery or at the nearest suitable available point. The meters for the measurement of electrical power shall be provided installed and kept in repair by the Commission. The Customer if called upon by the Commission to do so shall furnish sufficient and proper space in his building or some other suitable place for the installation operation and maintenance of the meters and the necessary series and potentiometer transformers for use with the said meters.

The Customer shall also provide the right of way for the transmission line selected by the Commission across the property owned or controlled by the Customer and keep the same clear of all buildings, trees and brush for a distance of one rod on each side of the centre line during the continuance of this agreement.

(f) The Commission shall be entitled at the expiration of this agreement to remove all the Commission's plant, apparatus or equipment from the Customer's premises, including all meters, transformers, etc.

3. It is further agreed:

(a) If at any time the demand for power exceeds the amount held in reserve or an amount greater than that then permissible by the terms of this agreement, the amount held in reserve shall thereby automatically increase by an amount equal to such excess above the specified or permissible amount held in reserve, and such increased amount shall thereafter be purchased and paid for until a greater amount shall be taken in accordance with the terms of this contract, or by, or on account of another demand for power above that permissible by the terms of this contract.

(b) Payments shall be made in gold coin of the present standard of weight and fineness and bills shall be rendered by the Commission on or before the first, and paid by the Customer on or before the fifteenth of each month. If any bill remains unpaid for fifteen days, the Commission may, in addition to all other remedies and without notice, discontinue the supply of such power to the Customer in default until such bill is paid. No such discontinuance shall relieve the Customer in default from the performance of the covenants, provisions and conditions herein contained. All payments in arrears shall bear interest at the legal rate.

(c) Said power shall be three-phase, alternating at a periodicity of approximately 25 cycles, and at approximately 550 volts, and shall be commercially continuous 24 hour power every day of the year except as provided hereunder.

The maintenance by the Commission of approximately the agreed voltage, at approximately the agreed frequency at the 550 volt terminals of the step-down transformers at the point of delivery shall constitute a supply of all power involved herein and the fulfilment of all the operating obligations hereunder, and when the voltage and frequency are so maintained, the amount of power, its fluctuations, load factor, power

factor, distribution as to phases and all other characteristics and qualities are under the sole control of the Customer, his agents, apparatus, appliances and circuits.

(d) The step down transformers and controlling apparatus shall be furnished, kept and maintained in good order by the Commission and the customer shall select and use transformers and apparatus suitable to receive the electric power produced by the apparatus of the Commission. Also the Customer's transmitting, transforming, translating, and wherever possible all other apparatus and devices upon his circuits shall be first-class, modern, standard design and construction in commercial use and shall be operated and maintained with special reference to securing high efficiency and good operation, not only of its own, but also of the apparatus of the Customer when receiving power from the Commission; and the Customer shall install upon and equip his circuits with such approved protective devices as are in commercial use and operate its circuits in such a manner as will to the then greatest extent protect the apparatus and circuits of the Commission, and its own apparatus and circuits from damage and interruption from lightning, short circuiting and otherwise; all apparatus, machinery and wiring to be approved of by the Commission.

(e) In case the Commission shall be prevented from delivering said electric power for one-half hour continuously, or in case the Customer shall be prevented from receiving said electric power for one-half hour continuously, by strike, riot, fire, lightning, invasion, explosion, act of God or the public enemies or any other cause reasonably beyond its control, then the Customer shall not be liable to pay for such power during such period but nothing herein contained shall be construed as permitting the Commission to refuse to deliver power or the Customer to refuse to receive the same as soon as the cause of interruption is removed, and each of the parties hereto shall be prompt and diligent in removing and overcoming such cause or causes.

(f) The Commission may at any time between the hours of one o'clock and five o'clock a.m., on any day in the month, during the term of this contract, suspend the delivery of electric power under this contract, for the purpose of making repairs upon or improvements in any part of its transmission or distributing system, provided, however, that the Commission shall in every case give to the customer such reasonable notice thereof as circumstances will permit. Deduction in this case shall be in accordance with 3 (e). If however by prearrangement with, and consent of the customer, the delivery of electric power should be suspended for the above purposes for more than one day above provided for, or at any other hours than those specified, deduction for such additional time or times shall be in accordance with 3 (e).

(g) This agreement shall extend to, and be binding upon and enure to the benefit of the successors and assigns of the parties hereto respectively.

IN WITNESS WHEREOF the parties hereto have affixed their seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

{ HYDRO-ELECTRIC POWER
COMMISSION OF ON-
TARIO.

(Sgd.) A BECK, *Chairman.*

(Sgd.) W. W. POPE,

Secretary.

[SEAL.]

{ THE STANDARD WHITE LIME
COMPANY, LIMITED.

(Sgd.) JOHN KENNEDY.

President.

RIGHT OF WAY.

Organization.

The organization employed to secure right-of-way for the transmission lines was under the direct supervision of the Solicitor of the Commission until the fall of 1909, after which date the newly-appointed secretary was placed in charge of these operations and all payments made by the Commission itself. At that time, a chief agent and three assistants constituted the right-of-way organization.

Legal Proceedings.

The acquisition of the necessary contracts and agreements was made extremely difficult, particularly between Niagara Falls, Dundas and Toronto, chiefly because of the continued agitation provoked by the opponents of the power scheme, who, later in November, 1909, resorted to court proceedings, and applied for an injunction to restrain the Commission on the ground that the Power Commission Act of 1909 did not authorize it to acquire easements. This injunction was granted and heard before Chief Justice Sir Glenholm Falconbridge at the sittings of the Assizes held in Toronto, in January, 1910, at which hearing the injunction was dissolved and the action dismissed. An appeal was then entered against this judgment to the Court of Appeal, but at the Sitting of that Court, the judgment of the Lower Court was sustained. It was further claimed in this latter litigation that the Power, Commission Act of 1909, did not clearly specify the method which should be employed in determining the amount of the remuneration, if any, to be paid to the property owners, upon whose land the Commission had secured easements. The enactment of "The Power Commission Act of 1910" makes clear the powers of the Commission, and settled this dispute.

High Tension Lines.

Notwithstanding these legal proceedings, right-of-way for upwards of two hundred miles of high tension line was acquired together with the necessary agreements and easements from nearly two thousand different property owners. Only seven arbitrations were held over the amount of remuneration to be paid, and in the majority of cases, the previous offers of the Commission were practically sustained by the final awards.

Considerable difficulty was experienced with the farmers on whose land easements had been secured, relative to the cutting and removal of trees likely to interfere with the transmission lines, and as a result, the Commission finally organized tree cutting gangs, which, under its direction, cut and removed the necessary trees on these properties as well as along the public highways.

Telephone and Relay Lines.

Right-of-way for the construction of 290 miles of telephone and relay line both across private properties and along the public highways was also acquired at the same time, and agreements and easements were secured, for a period of thirty years with the privilege of renewal at the expiration of the term, which provided a route one rod wide clear of all buildings, trees and obstacles, and permitted the erection of poles, stringing of wires, cutting and removal of all and any trees which would interfere with the line. Arrangements were also made with the Town Coun-

cils where the line passed along public highways for cutting and removing the trees along the roadside, and negotiations made with adjoining property owners for the privilege of placing necessary guys and braces on their land. These operations involved an immense amount of time for the right-of-way staff, but the work was practically completed during the year 1910, and the right-of-way staff reduced to a chief agent and one assistant.

Low Tension Lines.

The construction of low tension lines was started in June, 1910. The Commission having decided to supervise the construction of the lines instructed its agents to acquire the necessary right-of-way and agreements for placing poles across private properties as well as along public highways. Privileges similar to those obtained for the high tension and telephone lines, i.e., to cut and remove those trees likely to interfere with the line, were also secured, gangs organized which cleared 120 miles of right-of-way across private properties, and between 150 and 160 miles along the public highways.

CROSSINGS.

The provisions of the Dominion Railway Act relating to high and low tension transmission lines crossing either over or under the tracks of steam or electric railway, or the lines of telegraph or telephone companies, require that application to secure sanction for these constructions, be made to the Board of Railway Commissioners at Ottawa. The applications must then be ratified in an Order issued by the Board, and the crossings after completion, inspected and approved by the Government Electrical Engineer before the lines can be placed in operation.

The Commission filed applications for permission to construct 250 high tension, and 60 low tension crossings. Surveys were made and triplicate plans prepared, which, with a large amount of correspondence relating to interviews and negotiations involving a large amount of work for the engineering and secretarial departments were furnished in every case to the Railway Commission as well as the companies interested, and orders secured from the Railway Boards at Ottawa and Toronto covering the same.

CHAPTER II.

TRANSMISSION SYSTEM.

HIGH TENSION LINES

Surveys.

All preliminary surveys had been practically completed in 1909, but it was necessary to keep several small transit parties in the field to locate towers in advance of the contractor's construction gang. There were three of these parties, each consisting of four men, including the transit men, employed on November 1st, 1909. Party No. 1 was at that time working between Preston and Berlin in Section "G"; Party No. 2, west from Dundas towards Woodstock in Section "C"; and Party No. 3, between Guelph and Preston in Section "G." The following tower locations had been established at this date by these organizations:—

Sec. "A"—Line completed, 568 towers in all.

Sec. "B"—Location completed from Dundas to Etobicoke Creek, 325 towers.

Sec. "C"—Location completed to Tower No. 62.

Sec. "E"—Location completed to Tower No. 212.

Party No. 1 started working in Section "A" on July 4th, 1909, and Parties No. 2 and 3 were ordered into the field when the contractor's rate of progress required them.

A number of men were laid off or transferred to other work at the end of November, 1909, and one party organized which worked all winter in Sec. "E" between Woodstock and London, and also located the line in Sec. "K" between London and St. Thomas.

This party was further divided in March, one division starting to locate towers in Section "E," while the other, after completing the tower locations from Etobicoke Creek to Toronto City limits, was transferred to Sec. "K." The work of tower location was completed throughout the system by the end of July, 1910, and the last party disbanded. In addition to the regular work of locating towers, these parties also made detailed surveys and profiles of all railroad, transmission, telephone and telegraph line crossings. There were about one hundred and sixty of these crossings for which the Board of Railway Commissioners required plans before construction could be commenced.

It was also necessary to make a special survey of the route from the Toronto City Limits to the Strachan Avenue Station. Special towers were required for this portion of the line, eighteen of which were located in the water along the Lake Shore.

Organization.

The contractor's field organization was the same in 1910 as in 1909, and consisted of tower footing, tower assembling and tower erecting gangs. In October, 1909, insulator erecting gangs started work, and in May, 1910, cable erecting

gangs were added to the organization. Inspectors accompanied all construction gangs, as in 1909, to check and supervise the details of construction in the interests of the Commission.

The engineer in charge of transmission line construction had the general supervision of the work, and was assisted by resident engineers who were in charge of certain sections. Two resident engineers were able to cover the work until March, 1910, when an increase in the contractor's working force with the coming of spring made it necessary to employ a third resident engineer and divide the territory into three instead of two sections, as follows:—Section No. 1 from Niagara Falls to Woodstock, Section No. 2 from Toronto to St. Mary's, Section No. 3 from



Standard Single Circuit Tower.

Woodstock to London and from St. Mary's to St. Thomas. The latter organization was maintained until the completion of the contract and the various construction gangs were disbanded as their portion of the work was completed.

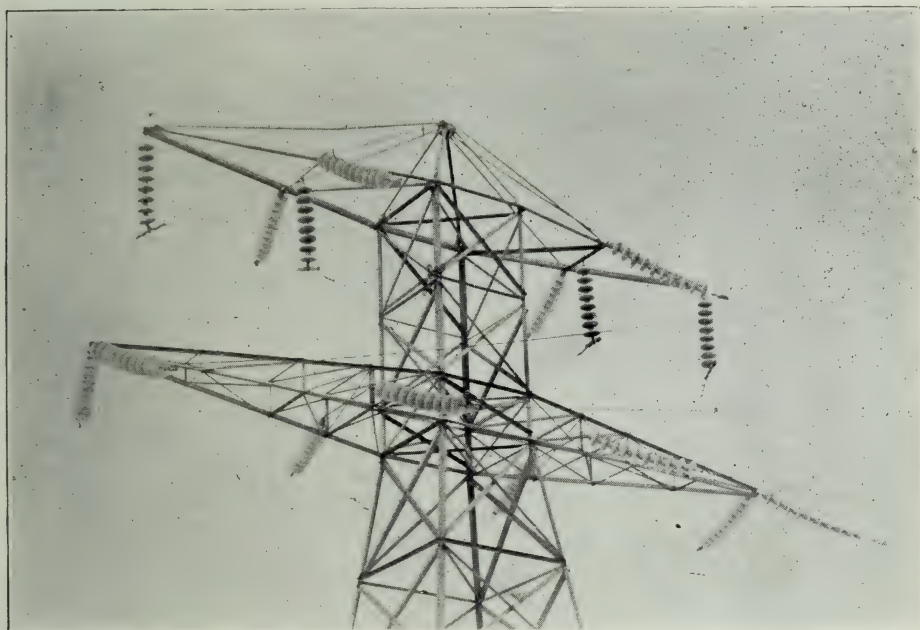
Progress of Construction,

The Construction work accomplished by the contractor up to October 31st, 1909, may be briefly summarized as follows:—

Towers delivered in the field	570
Tower footings set	430
Towers assembled	380
Towers erected	375
Insulators erected	888

The construction work remaining to be done at the beginning of the fiscal year of 1910 was as follows:—

Towers to be delivered in field	2,470
Tower footings to be set	2,610
Towers to be assembled	2,260
Towers to be erected	2,665
Insulators to be erected.....	13,008
Power cable to be erected	1,103.4 miles.
Ground cable to be erected	708.3 miles.

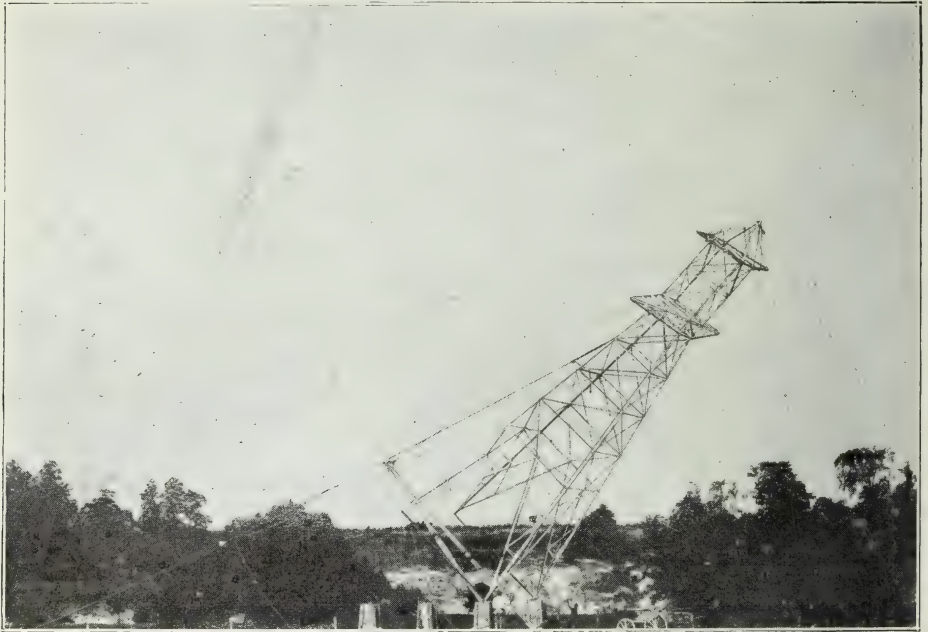


Details Transposition Tower.

The ground organization employed during the winter differed but little from that of the summer. A considerable amount of special work was done on tower footings, notably the rock footings for the line towers between Guelph and Preston, and the footings in the Puslinch Swamp between Dundas and Guelph. Also a large number of wet footings were placed which had been purposely neglected during the summer in order that as much footing construction as possible might be completed in the dry locations under favorable working conditions. Owing to the necessity for shoring, sheet-piling and unwatering, the work on wet footings was very slow, but the costs were less than if this work had been done in summer, as the ground water was low and the muck more or less frozen.

Steel was delivered throughout the winter, and the assembling and erection of towers as well as the suspension of insulators was continued. The low teaming costs made possible by the winter were advantageous for the delivery of material, particularly the steel.

The contractor materially increased his construction force in the spring of 1910, and by the end of April work on the towers was being carried on simultaneously in Section "A," Niagara Falls to Dundas; Section "B," Dundas to Toronto; Section "C," Dundas to Paris; Section "D," Paris to Woodstock; Section "E," Woodstock to London; and Section "H," Berlin to Stratford. During the first week in May, 1910, a cable erecting gang was added to the organization. This gang, starting at Guelph, worked south towards Dundas. Shortly after, two more cable gangs were organized, and by the end of June, 1910, the maximum working force of the contractor was in the field. One complete construction force unit of about 92 men, including a footing, assembling, erecting and cable gang could, at this time, complete one-half mile of double, or three-quarters of a mile of single-circuit line in a working day under average conditions.



Tower Erection.

The work was continued throughout the summer without interruption, and the gangs disbanded as various classes of work were completed. Exclusive of the organization later employed in constructing the three miles of line within the City Limits of Toronto, the cable gangs were the last in the field, and erected the final section of aluminum cable on December 17th, 1910. During the period of eighteen months from July 15th, 1909, a total of 278 miles of high tension line had been constructed.

The city had not provided the right-of-way between the City Limits of Toronto and the Strachan Avenue Station by the 17th of December, as previously agreed, and as a result about three miles of the necessary 281 miles of high tension line remained unfinished at this date.

The first tower was erected on July 22nd, 1909, and the last, exclusive of the Toronto entrance, on November 15th, 1910. The first cable was erected on May

23rd, 1910, and the last on December 17th, 1910. During this latter period of seven months, about 1,103 miles of aluminum and 708 miles of steel ground cable had been erected. The best progress was made during the month of October, 1910, when 211.5 miles of aluminum and 117.5 miles of ground cable were strung.

A summary of work done under the McGuigan contract up to date of completion, December 17th, 1910, is as follows:—

SEC. "A"—NIAGARA FALLS TO DUNDAS.

Distance—51 miles.	
Number of towers erected complete	568
Number of insulators erected complete	3,912
Mileage of power cable erected	312.2
Mileage of ground cable erected	207.7

SEC. "B"—DUNDAS TO TORONTO (CITY LIMITS).

Distance—39.1 miles.	
Number of towers erected complete	431
Number of insulators erected complete	3,102
Mileage of power cable erected	216.7
Mileage of ground cable erected	155.0

SEC. "C"—DUNDAS TO PARIS.

Distance—22.6 miles.	
Number of towers erected complete	251
Number of insulators erected complete	834
Mileage of power cable erected	68.5
Mileage of ground cable erected	45.6

SEC. "D"—PARIS TO WOODSTOCK.

Distance—21.8 miles.	
Number of towers erected complete	231
Number of insulators erected complete	756
Mileage of power cable erected	66.1
Mileage of ground cable erected	44.0

SEC. "E"—WOODSTOCK TO LONDON.

Distance—25.4 miles.	
Number of towers erected complete	278
Number of insulators erected complete	924
Mileage of power cable erected	76.2
Mileage of ground cable erected	51.3

SEC. "F"—DUNDAS TO GUELPH.

Distance—25.3 miles.	
Number of towers erected complete	270
Number of insulators erected complete	885
Mileage of power cable erected	76.7
Mileage of ground cable erected	51.1

SEC. "G"—GUELPH TO BERLIN.

Distance—19.1 miles.	
Number of towers erected complete	206
Number of insulators erected complete	705
Mileage of power cable erected	57.9
Mileage of ground cable erected	38.6

SEC. "H"—BERLIN TO STRATFORD.

Distance—25.1 miles.	
Number of towers erected complete	267
Number of insulators erected complete	861
Mileage of power cable erected	76.1
Mileage of ground cable erected	50.7

SEC. "I"—STRATFORD TO ST. MARYS.

Distance—13.5 miles.	
Number of towers erected complete	147
Number of insulators erected complete	510
Mileage of power cable erected	40.9
Mileage of ground cable erected	13.6

SEC. "J"—ST. MARYS TO LONDON.

Distance—23.6 miles.	
Number of towers erected complete	250
Number of insulators erected complete	867
Mileage of power cable erected	71.5
Mileage of ground cable erected	23.8

SEC. "K"—LONDON TO ST. THOMAS.

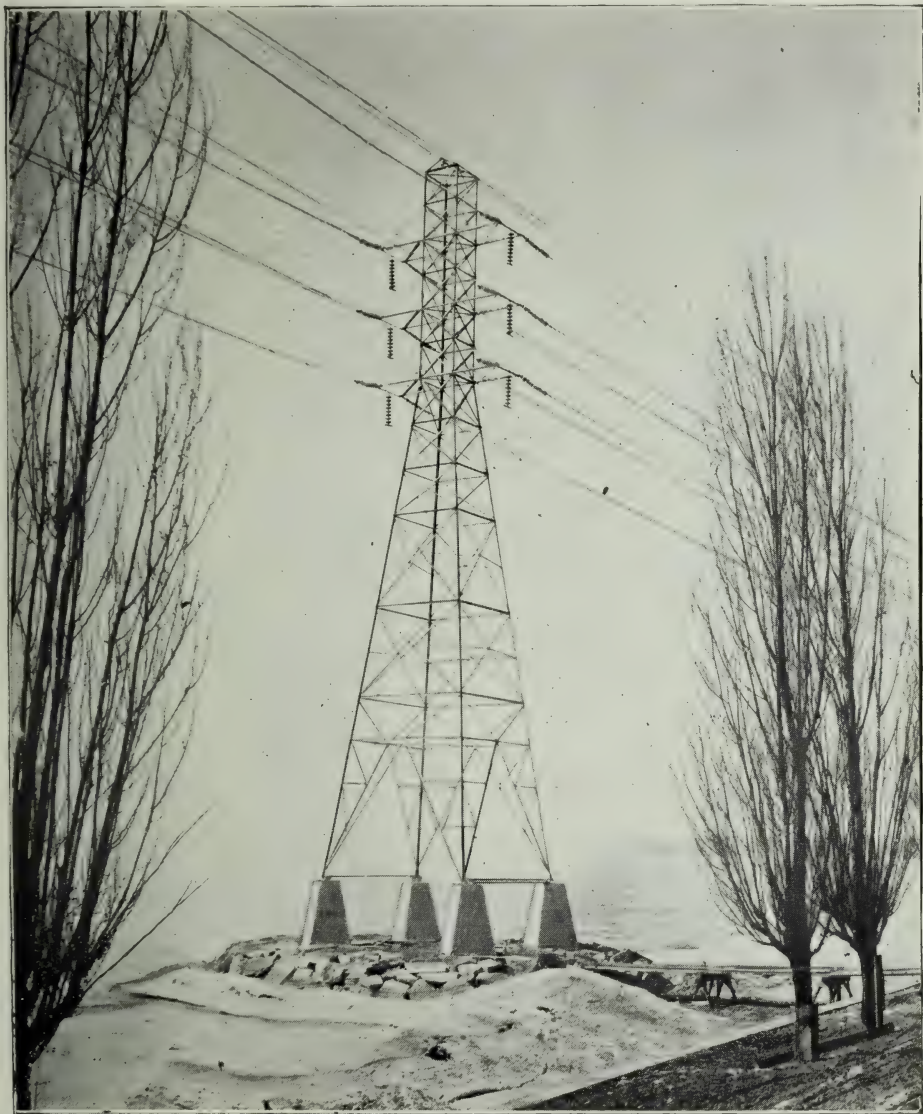
Distance—13.4 miles.	
Number of towers erected complete	141
Number of insulators erected complete	540
Mileage of power cable erected	40.6
Mileage of ground cable erected	26.9

TOTAL OF ALL SECTIONS.

Total Mileage	280.3
Total number of towers erected complete	3,040
Total number of insulators erected complete ..	13,896
Total mileage of power cable erected.....	1,103.4
Total mileage of ground cable erected	708.3

Special Constructions.

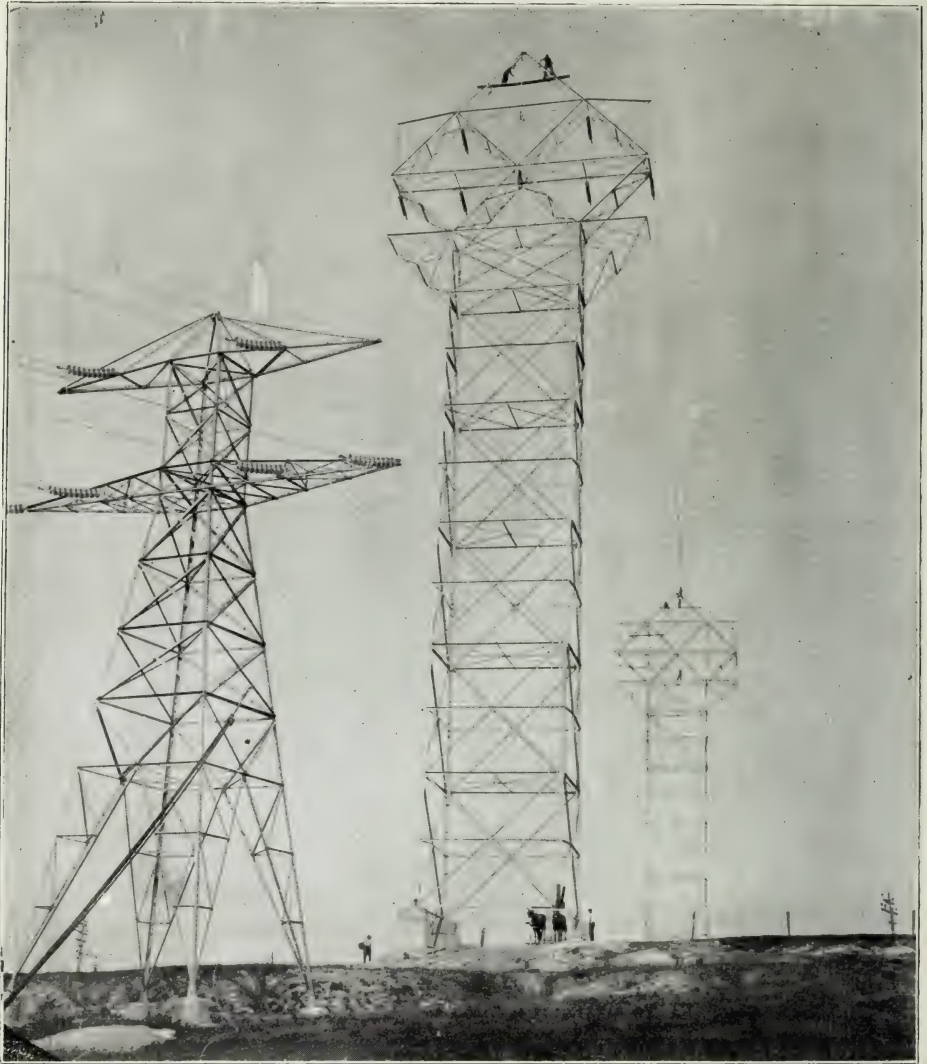
The most important special construction was the three miles of line between the Toronto City Limits and the Strachan Avenue Station. Owing to the grade separation work on the Grand Trunk and the City's work on the sea-wall, there was considerable delay in the negotiations with the Board of Railway Commis-



Toronto Entrance Tower.

sioners and the final acquisition of the necessary right-of-way. The original survey located the line through High Park parallel to the Grand Trunk tracks, but when the Railway Company's plans were completed it was found that the railway required so much space that it was not feasible to parallel their tracks. The locations finally decided upon follow the lake shore from Grenadier Pond to Jameson

Avenue. Here they leave the shore and run diagonally across to the north-west corner and along the north side of the Exhibition Grounds, and then diagonally across Garrison Commons to the station at the foot of Strachan Avenue. Forty towers with an over-all height above piers of approximately 100 ft., and designed to support the conductors with a minimum clearance of 70 ft. above ground, were required for this line. These towers were built on reinforced concrete footings,



Welland Canal Crossing.

eighteen of which were located in from two to five feet of water along the lake shore, with their tops 15 ft. above water level. The pier bases in the lake were protected by heavy hand-laid rip-rap and further reinforced by steel girders tied into the tops of the piers. The work on this portion of the line was begun on the 25th of September, 1910, and completed about the 15th of April, 1911. The slow progress results from the heavy nature of the work, and unfavorable weather

conditions, which caused the destruction of large sections of the coffer-dams and other temporary structures, the work having been seriously delayed on more than one occasion by storms. The necessity of erecting the towers piece by piece also gave cause for slow progress, since their location and weight made it impossible to erect them after assembly, as had been done on the rest of the line. It was also very difficult to keep men on the towers during the cold weather, and as a consequence, the progress of the cable erection was considerably delayed.

Another important piece of special construction was necessary seven miles west of Niagara Falls at the Welland Canal, where a minimum water-way clearance of 150 ft. is required by the Department of Railways and Canals. To comply with these requirements two towers were built each weighing twenty-five tons and having an over-all height of 168 ft. These were erected on heavy reinforced concrete footings on either side of the canal. The length of the crossing span is 419 ft.

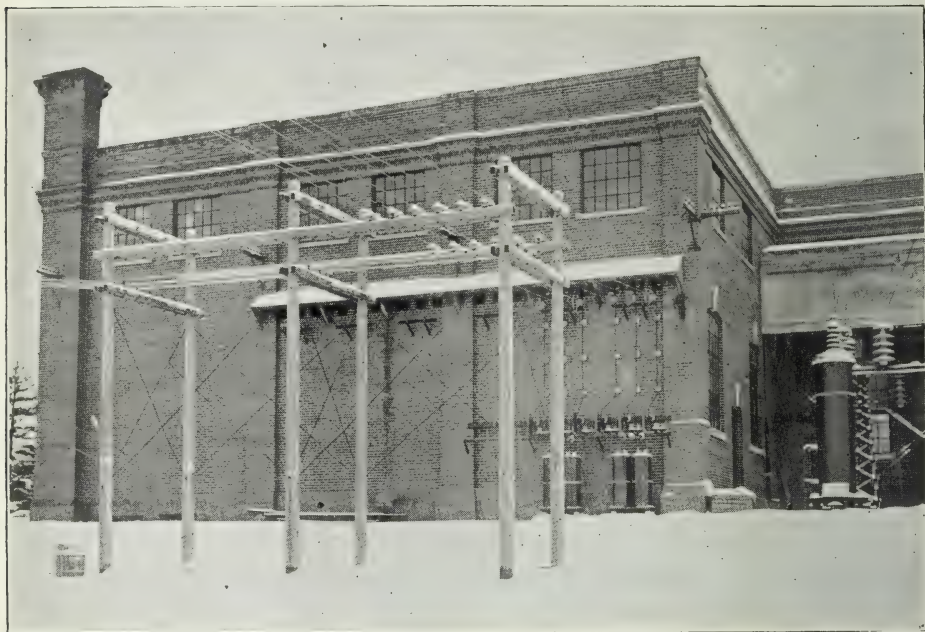
At Libby Lake, ten miles west of Paris, it was found necessary to place a corner tower on solid bottom, 17 ft. below water-level. A pile cluster foundation capped with a heavy reinforced concrete pier was employed. The same type of construction was also used in crossing the Humber River, a short distance north of the lake shore road.

LOW TENSION LINES.

The Commission first directed its attention to the construction of low tension lines in January, 1910, and sent an engineer to Hamilton to locate a suitable route for a line from the Dundas Transformer Station to the Beach Pump Station at Hamilton.

During the interim between the location of the pole line and the organization of the first low tension construction gang on June 20th, 1910, standard specifications were prepared and adopted by the Commission.

Actual construction on the first low tension line was begun on July 13th, 1910, and by the following October other gangs had been organized and were employed on additional construction.



Low Tension Structure, Dundas Station.

Right-of-Way.

The low tension lines have been erected along the most direct routes and as a rule border the public highways, although in some cases, where it was found either impossible or impracticable to follow the course of the highway, the lines were erected across country on private property; these latter routes being employed in several cases to avoid long detours, since numerous angles in the line would require excessive guying and bracing of the poles and materially increased the cost of the construction.

Easements to provide for the location of stub poles, anchors and guys, and the erection of the line on private properties were secured by the Right-of-Ways Department after complete data, including a sketch showing the desired location of the poles or anchors and giving the name of the owner, lot number, concession number and township, had been forwarded to the head office from the field and

plans prepared for registration. The Right-of-Way Department also secured agreements to provide for the cutting and trimming of trees along the highways and on private properties, and had secured by October 31st, 1911, right-of-way for 17.2 miles, and tree trimming and cutting contracts for 153.17 miles of line.

Standard Construction.

Idaho Cedar Poles, with an average height of 40 ft., a top diameter of $7\frac{1}{2}$ in., and a butt diameter of approximately 17 in. are employed throughout the distributing system except where special steel structures are employed for crossings.



Low Tension Pole Line.

The low tension lines as a rule are operated at a standard potential of 13,200 volts, although in a few instances other potentials are being employed. At the present time there are only two lines more than twenty miles in length, *i.e.*, Woodstock to Tillsonburg 21.42 miles, and Stratford to Seaforth 27.35 miles. All lines were constructed to standard specifications and inspected by the engineers of the Commission before being placed in operation.

A special line operating at 6,600 volts potential was constructed from Preston sub-stations to the Municipal Stations of Preston and Galt, and the station of the Galt, Preston and Hespeler Electric Railway.

Extent of System.

On October 31st, 1911, 153.17 miles of line had been erected and were in operation in the various sections of the transmission system.

The mileage of the various pole lines completed and under construction on this date are as follows:—

Total length of low tension lines.....	186.69 miles.
“ “ pole lines	176.19 “
“ “ single circuit lines	67.46 “
“ “ double circuit lines	119.23 “
“ “ low tension telephone line	171.29 “
Total number of poles.....	8256
Length of line completed.....	153.17 miles.
“ “ under construction	18.77 “

Description of Lines.

LOW TENSION LINE.

Voltage.	Total Mileage.	Total Mileage, Single Circuit.	Total Mileage, Double Circuit.	Remarks.
22,000	4.50	4.50	.....	Line from Midland to Penetanguishene.
13,200	169.38	56.46	112.92	
6,600	10.31	4.52	5.79	
2,200	2.50	1.98	.52	Dundas to Dundas and Hamilton Asylum Lines.

GAUGE, LENGTH AND WEIGHT OF CABLE AND WIRE.

Gauge, Brown & Sharp.	Wire, Miles.	Weight, Pounds.	Mileage, Single Circuit.	Mileage, Double Circuit.
400,000 C.M. Aluminum Cable.....	2.29	4,406	.53	.....
250,000 C.M. Copper Cable. D.B.,W.P.	1.95	8,855	.45	.....
No. 4/0 Aluminum Cable.....	36.47	37,491	.....	5.79
No. 3/0 “ “	22.86	5,852	7.26	.....
No. 0 “ “	305.51	156,726	9.41	43.79
No. 2 “ “	586.52	189,445	47.94	69.13
No. 2 Copper, Bare	5.89	6,267	1.87	.....
No. 4 “ D.B.,W.P.....	3.27	2,517	.....	.52
Totals.....	964.76	411,559 = 205.8 tons	67.46	119.23

LOW TENSION TELEPHONE LINE.

Gauge, Length and Weight of Copper Clad Steel Wire.

Gauge, Brown & Sharp.	Wire, Miles.	Weight, Pounds.	Mileage, Single Circuit.
No. 10.....	277.32	42,707	132.06
No. 8.....	82.83	20,293	39.23
Totals....	360.15	63,000 =31.5 tons.	171.29

Total wire miles, weight of all aluminum cable, copper cable, copper wire, copper clad steel wire and ground cable used on lines completed or under construction to Oct. 31st, 1911:—

Cable or Wire.	Wire, Miles.	Weight, Pounds.	Remarks.
Aluminum Cable.....	953.65	393,920	
Copper Cable.....	7.84	15,122	
Copper Wire.....	3.27	2,517	
Copper Clad Steel Wire	360.15	63,000	
$\frac{1}{4}$ -in. Stranded Steel Cable.....	184.03	134,084	Ground Wire.
Totals	1,508.94	608,643 =	304.4 tons.

The poles used for the low tension lines within the corporate limits of London, Berlin, St. Thomas and Galt were supplied and erected by the various municipalities. The Commission erected only the power cables. On all other sections the Commission supplied all material and built the lines.

LIST OF LOW TENSION LINES, SHOWING SECTION NUMBER, NUMBER OF POLES, NUMBER OF CIRCUITS, SIZE OF CABLE AND MILEAGE OF LINE.

Sec.	From	To	No. of Poles.	Size of Cable.	No. of Circuits.	Mileage.
1	Dundas Sub. H.E.P.C.....	Junction Pole No. 134	134	1/0	2	2.84
2	Junction Pole No. 134	Beach Pump House	323	1/0	2	6.34
3	Junction Pole No. 134	Asylum Pump House.....	67	2	1	1.13
4	Berlin Sub. H.E.P.C.....	Junction Pole No. 10	10	1/0	2	.17
5	Junction Pole No. 10	Waterloo	79	1/0	2	1.64
6	Junction Pole No. 10	Berlin Corp. Station.....	35	1/0	2	.38
7	Berlin Sub. H.E.P.C.....	New Hamburg.....	556	2	2	12.27
8	Woodstock Sub. H.E.P.C....	Ingersoll.	453	1/0	2	9.87
9	Woodstock Sub. H.E.P.C....	Junction Pole No. 508	508	1/0	2	11.12
10	Junction Pole No. 508	Tillsonburg	467	1/0	2	10.30
11	Junction Pole No. 508	Norwich	207	2	1	4.59
12	St. Thomas Sub. H.E.P.C....	St. Thomas Corp. Station..	50	1/0	2	1.13
13	Stratford Sub. H.E.P.C....	Stratford Corp. Station ...	78	2 copper	1	1.73
14	Preston Sub. H.E.P.C.....	Junction Pole No. 99	99	4/0-2	3	2.04
15	Junction Pole No. 99	Hespeler.....	99	2	1	2.08
16	Junction Pole No. 99	Galt.....	175	4/0	2	3.75
17	Preston Sub. H.E.P.C.....	Preston Corp. Station...	11	2 copper	1	.14
18	London Sub. H.E.P.C.	Junction No. 1, Pole No. 38	38	3/0-2	2	.79
19	Junction No. 1, Pole No. 38	Asylum	70	2	1	1.54
20	Junction No. 1, Pole No. 38	Junction No. 2, Pole No. 93	55	3/0	1	1.20
21	London Sub. H.E.P.C.	London Sub. No. 1.....	178	3/0	1	3.56
22	Junction No. 2, Pole No. 93	London Sub. No. 1.....	96	3/0-0	2	1.71
23	Junction No. 2, Pole No. 93	London Sub. No. 2.....	20	0	1	.31
24	London Sub. No. 1	Springbank	156	0	1	3.55
25	Dundas Sub. H.E.P.C.....	Dundas Town	58	400,000	1	.98
				C.M.	1	.53
26	Pt. Credit Sub. H.E.P.C....	Pt. Credit Lake Shore Rd.	129	2	2	2.74
26a	Pt. Credit Lake Shore Rd.	Pt. Credit Brickworks...	14	2	2	.24
27	Pt. Credit Sub. H.E.P.C....	Brampton.	510	2	2	11.29
28	Stratford Sub. H.E.P.C....	Junction Pole No. 648.....	648	2	2	14.39
29	Junction Pole No. 648	Seaforth.....	581	2	2	12.86
30	Junction Pole No. 648	Mitchell.....	63	2	2	1.27
31	Guelph Sub. H.E.P.C.	Ont. Agricultural College.	77	1/0	1	1.58
32	Guelph Sub. Station	Property	8	1/0	1	.09
33	Junction Pole No. 69	Guelph Prison.....	84	1/0	1	2.00
34	Pt. Credit Sub. H.E.P.C....	Weston	551	2	2	14.07
35	Preston Sub. H.E.P.C.....	G. P. & H. Rly.....	6	1/0	1	.20
36	Pt. Credit Junct. P. No. 84	Mimico (New Toronto)...	251	2	1	5.35
37	Midland S. Ry. & P. Co....	Penetang.....	223	2	1	4.50
38	Dundas Sub. H.E.P.C.....	Dom. Sewer Pipe Co.....	350	2	1	7.35
39	Hamilton Asylum P. H. ...	Hamilton Asylum	30	4 copper	2	.63
40	Junction Pole No. 260	Waterdown	72	2	1	1.50
40a	Dom. Sewer Pipe Co.....	Junction Pole No. 260	—	2	1	1.92
41	St. Thomas Sub. H.E.P.C....	Port Stanley.....	575	2	1	12.27
42	Tap. Sec. No. 8 Line at					
	Beachville	Standard White Lime Co.	2	2	1	1.00
	London W. W.....	Sanitarium	10	2	1	1.25

Progress of Work.

An engineer was sent to Hamilton early in January, 1910, to locate a suitable route for the low tension line from Dundas Transformer Station to the Beach Pump Station at Hamilton, and on April 4th, 1910, surveys were started for this pole line.

The first low tension construction gang was organized on June 20th, 1910. Construction work commenced July 13th, 1910, on the line from the Dundas Transformer Station to the Beach Pump Station, and has been carried on steadily since that date. Other construction gangs were organized and placed in the field in October, 1910.

The construction work completed by the Commission up to October 31st, 1911, may be briefly summarized as follows:—

Poles delivered and erected	8,256
Total length of line completed	153.17 miles.
Total length of line under construction	23.07 miles.

The following tabulation gives the dates to October 31st, 1911, on which construction work was started and completed on the different sections of the low tension transmission lines:—

Sec. No.	From	To	Con- struction Started.	Line Completed.
1 & 2	Dundas Sub. H.E.P.C.....	Beach Pump Station, Hamilton	July 13, 1910	Jan. 2, 1911
3	Junction Pole No. 134.....	Asylum Pump House	Dec. 3, 1910	Feb. 8, 1911
4 & 6	Berlin Sub. H.E.P.C.....	Berlin Municipal Station ...	Aug. 25, 1910	Sept. 11, 1910
5	"	Waterloo	Sept. 11, 1910	Nov. 25, 1910
7	"	New Hamburg	Sept. 11, 1910	Jan. 2, 1911
8	Woodstock Sub. H.E.P.C.....	Ingersoll	Nov. 14, 1910	Mar. 28, 1911
9 & 10	"	Tillsonburg	Jan. 2, 1911	Apr. 29, 1911
11	Junction Pole No. 508.....	Norwich	Feb. 13, 1911	Mar. 30, 1911
12	St. Thomas Sub. H.E.P.C....	St. Thomas Municipal Station	Dec. 14, 1910	Dec. 30, 1910
13	Stratford Sub. H.E.P.C.....	Stratford Municipal Station..	Built by Corporation of Stratford.	
14 & 16	Preston Sub. H.E.P.C.....	Galt.....	Oct. 8, 1910	Jan. 19, 1911
15	"	Hespeler.....	Oct. 8, 1910	Dec. 30, 1911
17	"	Preston Municipal Station ...	Built by Corporation of Preston	
18-23	London Sub. H.E.P.C.	All London Lines included	Oct. 26, 1910	Jan. 21, 1911
24	" No. 1.....	Springbank	Jan. 1, 1911	Jan. 7, 1911
25	Dundas Sub. H.E.P.C.....	Dundas Town	Dec. 1, 1910	Jan. 1, 1911
26 & 26A	Port Credit H.E.P.C.....	Port Credit Brick Works ...	Feb. 24, 1911	July 23, 1911
27	"	Brampton	Feb. 15, 1911	May 6, 1911
28, 29 & 30	Stratford Sub. H.E.P.C.....	Seaforth and Mitchell	Mar. 24, 1911	Sept. 13, 1911
31 & 32	Guelph Sub. H.E.P.C.	O. A. College.....	July 21, 1911	Sept. 29, 1911
34	Port Credit Sub. H.E.P.C.	Weston	Apr. 19, 1911	July 24, 1911
35	Preston Sub. H.E.P.C.....	G. P. & H. Railway.....	Mar. 13, 1911	Mar. 21, 1911
37	Midland, S. Rly. and P. Co.	Penetanguishene	June 7, 1911	July 18, 1911
38	Dundas Sub. H.E.P.C.....	Dominion Sewer Pipe Works ..	July 21, 1911	Oct. 11, 1911
39	Asylum Pump House	Hamilton Asylum	Sept. 26, 1911	Oct. 27, 1911
40	Junction Pole No. 260.....	Waterdown	Sept. 6, 1911	Sept. 28, 1911
40A	Dominion Sewer Pipe Works	Junction Pole 3260	Sept. 30, 1911	Oct. 7, 1911

Construction work was commenced on Section No. 36, Port Credit Junction Pole No. 84 to Mimico, on October 2nd, 1911, and on Section No. 41 St. Thomas to Port Stanley, on October 16th, 1911. Since these dates, the work has been continued steadily on these sections.

Construction had not been started on Section No. 42, Beachville Line, and Section No. 43 Dundas Sub. HEPC. to Bertram and Sons on October 31st, 1911.

Work Under Construction.

The following sections of line were under construction on October 31st:—

Section No. 36, Port Credit (Junction Pole No. 84, Sec. No. 26) to Mimico, which prior to date, 246 of the required 251 poles had been erected. The cable stringing had not been started, but the line was well under construction. Total mileage of line, 5.35 miles.

Section No. 41, St. Thomas to Port Stanley, which prior to date, 83 of the required 575 poles had been erected. The guying, bracing, and wire stringing had not been started, but the line was well under construction. Total mileage of line, 12.31 miles.



Low Tension Crossing.

Construction work on the line from Dundas Sub. Station to J. Bertram and Sons, and also on the line from Beachville to the Standard White Lime Kiln Co. had not been started, although the material for both lines had been delivered and was on the ground. Total mileage of lines under construction, 23.07 miles.

Costs.

The costs of construction varied considerably for the different sections of the low tension transmission lines, since the varying factors, such as the distance of transmission, which necessitated different sized conductor; the length of poles required, owing to local conditions, and the number of circuits carried.

The total expenditure for the construction of 186.69 miles of low tension lines to October 31st, 1911, was \$349,898.00.

TELEPHONE AND PROTECTIVE RELAY LINES.

Telephone System.

Communication between the various substations and municipalities served with Commission energy is secured through an extensive telephone system. A telephone exchange with an ultimate capacity of from fifteen to twenty-five lines, according to the relative importance of the station within the transmission system, is installed in each transformer station, and a main telephone line paralleling the high tension line is employed to connect the various Exchanges. The arrangement of lines in the telephone system is similar to that adopted for the high tension system; Niagara, Toronto, Dundas and London being termed Terminal Stations. The respective telephone lines terminate on individual drops in the Exchanges. Port Credit, Guelph, Preston, Berlin, Stratford, St. Marys, Woodstock and St. Thomas are through stations, bridged across the main telephone line and operated as party line stations. The through stations are located in a loop circuit, and may be sectionalized by means of special switches placed in the incoming and outgoing lines. In case of trouble, this arrangement permits the damaged section to be cut out of the loop circuit, while it in no way interferes with the use of any of the other Exchanges.

The telephone equipments were purchased in the open market, and are of standard American design and construction. The operation of a telephone system paralleling a high tension transmission line is generally rendered extremely difficult by the switching, accidental grounds or other disturbances occurring on the latter. Due to the high potential used on our system, the induced voltage on the telephone line is enough to cause the flow of considerable current through the equipments, and should the slightest leakage occur on one of the lines it would be sufficient to make communication practically impossible. Normally, that is, with perfectly balanced lines, the existing potential between lines, instruments and ground does not affect the operation of the system. However, it usually places the insulation of the equipment under an undue strain, much higher than the standard equipment is supposed to withstand, and is therefore not a desirable condition. This electrical strain may be obviated by placing bleeding coils across the line and ground, and thereby reduce the voltage of the line to practically ground potential. But then, again, this method does not take care of abnormal voltage surges induced upon the line from various causes, such as, for instance, the daily charging of the high tension electrolytic lightning arresters, high tension switching, accidental grounds on the line, or lightning disturbances.

Each of these causes has practically the same effect upon the telephone line, namely, the sudden charging of the line with a high potential with reference to ground which, under severe conditions, may rise to a value disastrous to the equipment unless the protective devices can divert and effectively reduce this voltage.

Telephone protective devices adapted to provide lines subjected to these conditions are not, at the present time, procurable in the open market. Various types of protective devices were employed on the system with little or no success. Standard fuses were also tried, but they were of insufficient capacity, and blew too frequently to be of real service, carbon arrestors of various makes and type became grounded too easily, and bleeding coils of so-called standard design would break down and become grounded, always drowning the entire system. Heat coils and similar devices were discarded soon after operation was commenced, since they

were susceptible to the slightest disturbance. The carbon gap arresters were also replaced by a vacuum type of protective device of German make, which considerably improved conditions, but these were again supplemented by an American made type with a larger current carrying capacity.

After a careful investigation of the conditions and requirements of the system, together with a number of trials and experiments, had been made, it was decided to employ a standardized protective equipment for the entire telephone system, and have it constructed by our own experts in accordance with the specifications and plans prepared by our engineers.

Telephone Equipment.

The complete protective equipment employed for each main line entering a station is mounted on a special switchboard slate panel 7 in. by 30 in. in size. A similar protective equipment, but less elaborate, is mounted on an adjacent panel. Each panel is designed to handle four local line connections. On a third panel is mounted the apparatus used for operating, consisting of ringing transformers, relays, and distributing terminals for the source of current supply. All panels are mounted side by side on a steel frame as near the line entrances as feasible, in order to reduce to a minimum the length of wire required from these entrances to the protective panels.

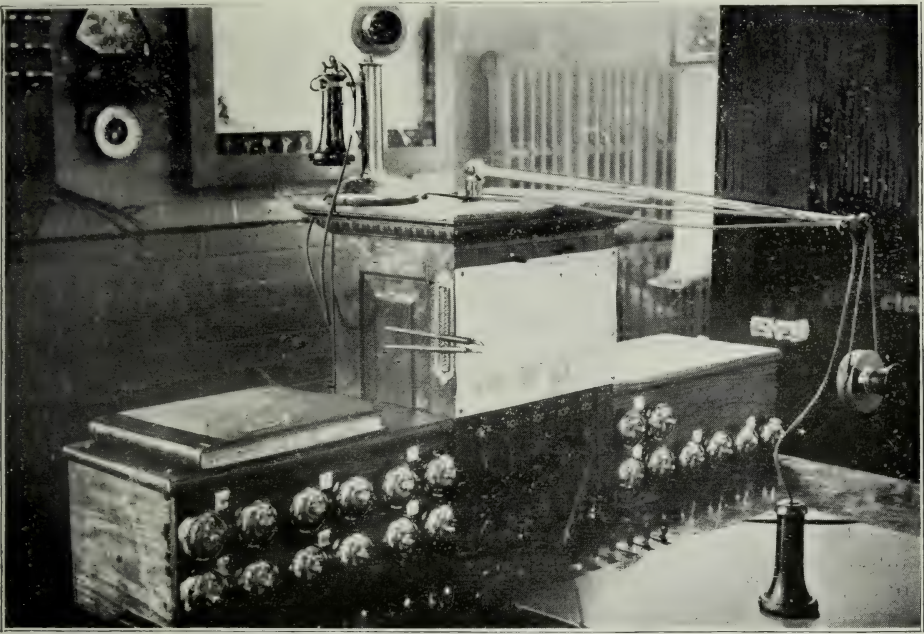
In addition to the protective equipment, the panels carry the switches previously mentioned for the sectionalizing of the line. The protective equipment proper consists of the following apparatus in the respective order in which they are in the line:—

- 2—600 volt, 12 amp., indicating cartridge fuses in series with line.
- 1—Vacuum type lightning arrester for metallic circuit across lines and ground.
- 1—Auxiliary copper tube gap arrester, across lines and ground.
- 1—Specially wound iron, open core choke coil, in series with line.
- 1—Bleeding inductance accurately balanced and well insulated, across lines and ground.
- 1—Bleeding condenser accurately balanced, across lines and ground.

When accidental non-arcing grounds occur on the high tension lines, or the phases become unbalanced, the induced charges on the line correspond to the line frequency of 25 cycles. These charges find an outlet to ground through the bleeding inductances, which are wound to offer very high inductive resistance to the taking currents, and low non-inductive resistance to the disturbing charges. The vacuum arresters are employed to clear the line of surges of high frequency, the result of a difference in potential between the line and the ground of approximately 300 volts or over. The great advantage of the vacuum type of arrester is the gradual breaking down of its dielectric resistance rather than an abrupt discharge, as results with the use of an ordinary air gap arrester. The electrodes of the vacuum arresters are separated about 1-16 in., and as a result there is little chance of carbon particles bridging this gap and grounding the line.

Choke coils with high inductive resistance are employed as a protection against high frequency surges passing the vacuum arrester. They are placed in series with the line and a condenser shunted across the line and ground. The condensers as well as the inductances are accurately balanced, and are grounded by means of a neutral tap.

The auxiliary gap arresters have been adopted as an additional protection against the excessively severe disturbances, which the vacuum arresters, in their present stage of development, are unable to withstand. The function of the auxiliary gap arresters is to provide an overflow to ground in case the induced voltages exceed the maximum values which the vacuum arresters and the shunted condensers can safely handle. These auxiliary gaps are so constructed that they will also prevent an increase in potential between lines over and above that which may be safely sustained by the telephone equipment. Should such a discharge cause a momentary short-circuit across the gap, the fuses will eventually blow, thereby disconnecting the equipment entirely from the line. Both fuses and auxiliary gap arresters may be quickly removed and examined without the use of tools, likewise all other apparatus on the panels without disturbing or removing any of the wires.



Telephone Exchange.

Up to the present time the equipment just described has given adequate and reliable protection to the telephone equipment, and practically uninterrupted service for the intricate system. The cost of maintenance for the entire telephone system corresponds, of course, to that of any other large installation, and since a large amount of business is transacted over the lines, the service is exceptionally hard. However, outside of ordinary delays occasioned by the wear and tear on the apparatus, there have been no further interruptions caused by the external electric disturbances.

Protective Relay System.

In addition to the ordinary relays provided at each of the stations for opening the circuit breakers when overloads or any similar troubles occur, special sets of line relays have been installed which are designed to automatically cut out faulty sections of the high tension lines without interfering with the energy supply

to any of the other stations. The use of a relay system of this type is made possible through the loop scheme of distribution which is employed throughout the Transmission System between Niagara Falls, Toronto and London. The western portion of the system embraces a loop starting at Dundas and extending to London, via Woodstock and back to Dundas through the municipalities of St. Mary's, Stratford, Berlin, Preston and Guelph. Thus, Guelph may be supplied around the loop from London instead of from Dundas directly, in case the Dundas-Guelph section of line is out of service. Line switches have been provided at each of the above mentioned stations which make it possible to cut out of the circuit any section of line between two stations by opening the proper switches at those stations.

The line protective relays are employed to open the two switches at either end of any section out of service, as just described. The operation is accomplished as follows:—

The small copper conductors are carried on the telephone poles parallel to the high tension lines and provide an electric circuit between adjacent stations and connected to the low tension windings of series transformers which are carried back on the lower ends of the high tension oil circuit breaker bushings.

The low tension windings at each end of any section are connected in series with each other and force a current through the relay wires proportional in value to the current flowing in the high tension line conductors, so long as the high tension line is in normal operating condition. Should a fault occur on the high tension line the current which flows in at one end of the high tension line section will be different from that which emerges from the other. This difference will result in different current values in the low tension windings of the series transformer at either end of the line, and naturally disturb the current flow in the relay wires. The series transformers are provided with a third set of windings named the tertiaries, which are connected to the trip coils of the respective oil circuit breakers. The different current values flowing in the secondary windings of the series transformers tend to induce a potential in the tertiary windings sufficient to cause current to flow through the trip coils, and thereby open the circuit breakers. This operation is accomplished at both ends of the line section simultaneously, and the section instantaneously cut out and rendered harmless, as well as preventing interruptions to other portions of the line.

Construction of Lines.

Organization.

The contractor's field organizations were similar in 1910 to those of 1909, and consisted of three pole erecting gangs. A fourth gang was organized in February, 1910, and employed to string wire on Section "B" between the Toronto and Dundas Stations.

One of the erecting gangs was re-organized on July 9th, 1910, when the greater part of the pole erection had been completed, moved from Niagara Falls to St. Thomas, and employed to string wire on Section "K" between the St. Thomas and London High Tension Stations.

The pole erecting gangs also did all the necessary guying and bracing of poles preparatory to stringing the wire. This organization was maintained until the completion of the contract; the various construction gangs being disbanded as they completed their sections of the line.

Every construction gang was accompanied by an Inspector who supervised the details of construction in the interest of the Commission.

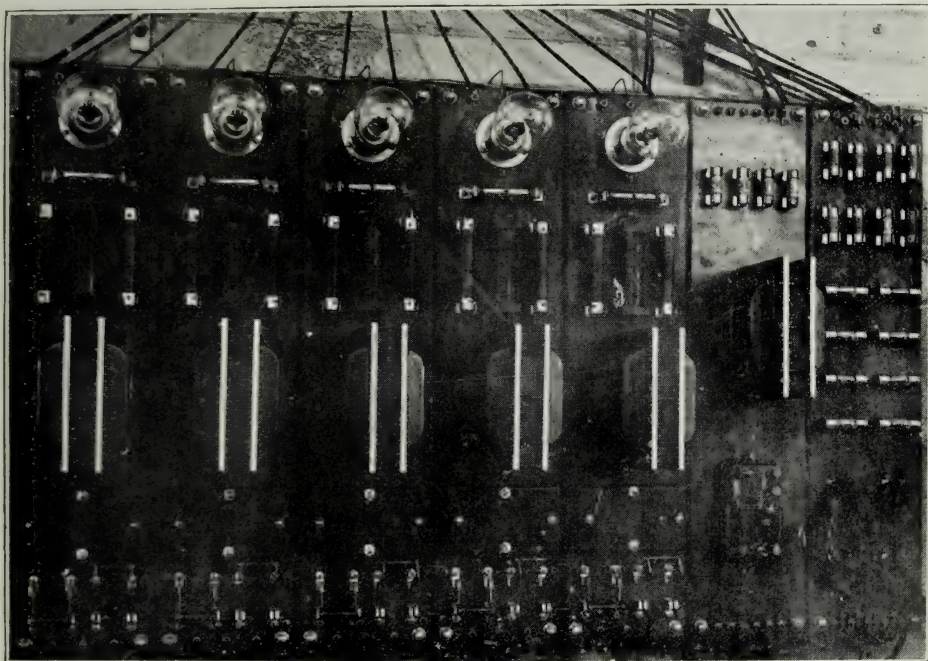
The field work on the Telephone and Relay Protective System was under the supervision of the Field Engineer in charge of construction, under whom were the Commission's Telephone Line Inspectors.

Daily progress reports were sent into the Toronto office by the inspectors, and also weekly reports, which were prepared under the supervision of and signed by the Field Engineer.

From these reports, tables, diagrams, etc., were compiled by the office staff, and a close check kept on the progress of the work in all parts of the system.

Progress of Construction.

During the winter of 1909, the number of Contractor's working force was reduced to two gangs, which were engaged in erecting the long poles and filling the



Telephone Protective Equipment.

gaps left in pole line in Section "A," Dundas to Niagara Falls, and Section "B," Dundas to Toronto.

These gangs also guyed and braced the poles preparatory to the stringing of the wire.

On February 26th, 1910, a third gang was organized, and wire stringing was started on Section "B," Dundas to Toronto.

On May 14th, 1910, the contractor organized another wire stringing gang, started them at Dundas on Section "F," Dundas to Guelph. Work was carried on continuously without interruption throughout the summer, and the gangs disbanded as the various sections and classes of work were completed. The last gang employed was a wire stringing gang, which completed the erection of the last section of telephone line on November 19th, 1910.

The first copper for the telephone and relay lines was erected February 26th, 1910, and the last on November 19th, 1910, approximately 1,547.64 miles of copper wire having been erected on these lines.

A summary of work performed by the contractor from October 31st, 1909, to the date of completion, November 19th, 1910, is as follows:—

SECTION "A"—NIAGARA FALLS TO DUNDAS.

Mileage of pole line erected	10.15
" " guying and bracing completed	54.15
" " telephone wire erected	227.45 double circuit
" " relay wire erected	227.45 double circuit

SECTION "B"—DUNDAS TO TORONTO.

Mileage of pole line erected	6.87
" " guying and bracing completed	35.87
" " telephone wire erected	75.32 single circuit
" " relay wire erected	150.65 double circuit

SECTION "C"—DUNDAS TO PARIS.

Mileage of pole line erected	3.00
" " guying and bracing completed	22.90
" " telephone wire erected	49.09 single circuit
" " relay wire erected	48.09 single circuit

SECTION "D"—PARIS TO WOODSTOCK.

Mileage of pole line erected	19.43
" " guying and bracing completed	21.53
" " telephone wire erected	45.21 single circuit
" " relay wire erected	45.21 single circuit

SECTION "E"—WOODSTOCK TO LONDON.

Mileage of pole line erected	19.03
" " guying and bracing completed	26.03
" " telephone wire erected	54.66 single circuit
" " relay wire erected	54.66 single circuit

SECTION "F"—DUNDAS TO GUELPH.

Mileage of pole line erected	0.12
" " guying and bracing completed	26.12
" " telephone wire erected	54.85 single circuit
" " relay wire erected	54.85 single circuit

SECTION "G"—GUELPH TO BERLIN.

Mileage of pole line erected	10.25	
" " guying and bracing completed	21.87	
" " telephone wire erected	45.92	single circuit
" " relay wire erected	45.92	

SECTION "H"—BERLIN TO STRATFORD.

Mileage of pole line erected	20.37	
" " guying and bracing completed	28.75	
" " telephone wire erected	60.37	single circuit
" " relay wire erected	60.37	single circuit

SECTION "I"—STRATFORD TO ST. MARY'S.

Mileage of pole line erected	5.50	
" " guying and bracing completed	15.28	
" " telephone wire erected	32.09	single circuit
" " relay wire erected	32.09	single circuit

SECTION "J"—ST. MARY'S TO LONDON.

Mileage of pole line erected	14.59	
" " guying and bracing completed	27.81	
" " telephone wire erected	58.40	single circuit
" " relay wire erected	58.40	single circuit

SECTION "K"—LONDON TO ST. THOMAS.

Mileage of pole line erected	16.09	
" " guying and bracing completed	16.09	
" " telephone wire erected	33.78	single circuit
" " relay wire erected	33.78	single circuit

TOTAL OF ALL SECTIONS

Total mileage of pole line erected	125.41	
" " guying and bracing completed	296.41	
" " telephone wire erected	736.15	
" " relay wire erected	811.48	

General Data.

A separate wooden pole line is employed to carry the High Tension Telephone and Relay Circuits, and has been erected generally parallel to and on the opposite side of the highways from the High Tension Lines.

Two circuits for both the telephone and relay systems were erected from the Niagara Falls Station to Dundas. This assures positive operation in case either of the two fail to operate. Between Dundas and Toronto two relay circuits and one telephone circuit were at first erected. Another telephone circuit is, however, at present being added to this section.

On all other sections of the High Tension System single circuit telephone and relay lines were erected.

The mileages of different sections of telephone and relay lines are as follows:

Sec. "A": Niagara Falls—Dundas	54.156 miles
Sec. "B": Dundas—Toronto	35.87 "
Sec. "C": Dundas—Paris	22.90 "
Sec. "D": Paris—Woodstock	21.53 "
Sec. "E": Woodstock—London	26.03 "
Sec. "F": Dundas—Guelph	26.12 "
Sec. "G": Guelph—Berlin	21.873 "
Sec. "H": Berlin—Stratford	28.75 "
Sec. "I": Stratford—St. Mary's	15.285 "
Sec. "J": St. Mary's—London	27.81 "
Sec. "K": London—St. Thomas	16.09 "

Total 296.414 miles

Constructions Completed on October 31st, 1909.

The construction work on the telephone and relay system completed by the contractors up to October 31st, 1909, may be briefly summarized as follows:—

Sec. "A": Niagara Falls—Dundas	44.00 miles
Sec. "B": Dundas—Toronto	29.00 "
Sec. "C": Dundas—Paris	19.90 "
Sec. "D": Paris—Woodstock	2.10 "
Sec. "E": Woodstock—London	7.00 "
Sec. "F": Dundas—Guelph	26.00 "
Sec. "G": Guelph—Berlin	11.62 "
Sec. "H": Berlin—Stratford	8.38 "
Sec. "I": Stratford—St. Mary's	9.78 "
Sec. "J": St. Mary's—London	13.22 "
Sec. "K": London—St. Thomas	0.00 "

Total 171.00 miles

Date of Final Completion and Total Mileage.

Construction work for the telephone and relay systems was completed on Nov. 19th, 1910; the last section of line being erected into Toronto on this date:—

Total mileage of pole lines (including all sections of system)	296.414 miles
Total number of poles erected	12.368 "
Total mileage of double-circuit telephone line	242.258 "
Total mileage of double-circuit relay lines	90.026 "
Total mileage of single-circuit relay line	206.388 "
Total wire miles of copper erected on telephone line	736.158 "
Total wire miles of copper erected on relay line	811.488 "

Following is summary of complete line data covering all sections:—

Section "A"—Niagara Falls to Dundas.

Distance, 54.156 miles.

Number of poles erected, 2,204.

Mileage of telephone wire erected, 227.455 (wire miles).

Mileage of relay line erected, 227.455 (wire miles).

Section "B"—Dundas to Toronto.

Distance, 35.87.

Number of poles erected, 1,519.

Mileage of telephone wire erected, 75.320 (wire miles).

Mileage of relay wire erected, 150.650 (wire miles).

Section "C"—Dundas to Paris.

Distance, 22.90.

Number of poles erected, 957.

Mileage of telephone wire erected 48.090 (wire miles).

Mileage of relay wire erected, 48.090 (wire miles).

Section "D"—Paris to Woodstock.

Distance, 21.53.

Number of poles erected, 888.

Mileage of telephone wire erected, 45.210 (wire miles).

Mileage of relay wire erected, 45.210 (wire miles).

Section "E"—Woodstock to London.

Distance, 26.03.

Number of poles erected, 1,074.

Mileage of telephone wire erected, 54.660 (wire miles).

Mileage of relay wire erected, 54.660 (wire miles).

Section "F"—Dundas to Guelph.

Distance, 26.12.

Number of poles erected, 1,093.

Mileage of telephone wire erected, 54.850 (wire miles).

Mileage of relay wire erected, 54.850 (wire miles).

Section "G"—Guelph to Berlin.

Distance, 21.873.

Number of poles erected, 935.

Mileage of telephone wire erected, 45.925 (wire miles).

Mileage of relay wire erected, 45.925 (wire miles).

Section "H"—Berlin to Stratford.

Distance, 28.75.

Number of poles erected, 1,164.

Mileage of telephone wire erected, 60.370 (wire miles).

Mileage of relay wire erected, 60.370 (wire miles).

Section "I"—Stratford to St. Mary's.

Distance, 15.285.

Number of poles erected, 634.

Mileage of telephone wire erected, 32.098 (wire miles).

Mileage of relay wire erected, 32.098 (wire miles).

Section "J"—St. Mary's to London.

Distance, 27.81.

Number of poles erected, 1,204.

Mileage of telephone wire erected, 58.40 (wire miles)

Mileage of relay wire erected, 58.40 (wire miles).

Section "K"—London to St. Thomas.

Distance, 16.09.

Number of poles erected, 696.

Mileage of telephone wire erected, 33.780 (wire miles).

Mileage of relay wire erected, 33.780 (wire miles).

CHAPTER III.

CONSTRUCTION OF STATIONS.

NIAGARA SYSTEM.

The construction of the station buildings for the transmission system as originally planned was well under way during the period of the last report. Work on these buildings was continued throughout the winter of 1909-1910, the majority of them were enclosed by spring, and all completed during 1910.

Very little difficulty was experienced in securing materials and labor for this work, excepting that the steel market became stringent during the progress of the work. Labor prices averaged $17\frac{1}{2}$ c. per hour. In addition to the construction of the stations proper, considerable grading and fencing has been done on the station sites; telephone and low tension lines have been conveniently arranged, and the condition of a number of roadways improved.

Standard Auxiliary Equipment.

Heating Systems.

Since there were a large number of heating systems to be installed, it was considered advantageous for the Commission to purchase boilers, radiators and valves direct from the manufacturers and award the contracts for the supply of piping and fittings as well as the installation of the systems to local heating contractors. The boilers were purchased prior to October 31st, 1909. Specifications for the radiators were sent to all manufacturers in Canada and the contracts awarded as follows:—

Niagara Falls, Dundas and Toronto stations, the Gurney Foundry Company; for the remaining stations, Taylor-Forbes Company.

Valve specifications were supplied all manufacturers or dealers in Canada as well as manufacturing companies in the United States. The specifications covered the valves required for the oil and water as well as for the heating systems. A superior type of valve was required for the former, and it was therefore necessary to choose a valve that would be most suitable for the service intended. Several tenders were received which did not meet our requirements, but after careful consideration of the different tenders and examinations of the samples submitted the contract was awarded to the Canadian Fairbanks Company.

Specifications for the installation of the heating system were submitted to all parties desiring them after a circular postal had been sent to each steamfitter in the district covered by our system to ascertain if they desired to tender on the work

Contracts were awarded as follows: —

Niagara Falls Station, Purdy, Mansell & Co., Toronto.	\$691 00
Dundas Station, Rodger, Gibson & Co., Hamilton....	495 00
Toronto Station, Keith & Fitzsimons, Toronto.	495 00
London Station, Noble & Rich, London.	525 00
Guelph Station, Stevenson & Malcolm, Guelph.	430 00
Berlin Station, J. Hainsworth, Berlin.	272 00
Preston Station, Bernhardt & Gies, Preston.	327 00
Stratford Station, McDonald & Henry, Stratford.	419 00
St. Mary's Station, McDonald & Henry, Stratford.....	444 00
Woodstock Station, Whitney Bros., Woodstock.....	443 00
St. Thomas Station, James Williams, St. Thomas.....	330 00

The installation of the heating, oil, water and compressed air systems was more or less complicated. Considerable attention was given the arrangement in the original lay-out, after which only a few changes were made and then principally in the first stations laid out. Return systems were installed where possible and all leads covered with standard insulation.

Steam is supplied the Woodstock station from a nearby steam power plant belonging to the municipality, and at all other stations from boilers located in the stations.

Lighting Systems.

Specifications were issued for the installation of conduits, cut-out boxes, wiring and connections necessary for a lighting system in each of the stations. Circular postals were first sent to all contractors and specifications forwarded all parties desiring them. Contracts were awarded as follows:

Niagara Falls Station, George J. Beattie, Toronto.....	\$750 00
Dundas Station, Keith & Fitzsimons, Toronto.....	630 00
Toronto Station, George J. Beattie, Toronto.....	830 00
London Station, Commercial Elec. Co., London.....	598 00
Guelph Station, Stevenson & Malcolm, Guelph.....	275 00
Preston Station, Geo. J. Beattie, Toronto.....	340 00
Berlin Station, Elec. Construction Co., Berlin.....	347 00
Stratford Station, Geo. J. Beattie, Toronto.....	371 00
St. Mary's Station, Geo. J. Beattie, Toronto.....	373 00
Woodstock Station, Geo. J. Beattie, Toronto.....	349 00
St. Thomas Station, Geo. J. Beattie, Toronto.....	388 00

The lighting fixtures employed were designed by the Commission and tenders requested for their manufacture. The contract was awarded to the James Morrison Company, Toronto.

Sockets, shades and holders were purchased from the Canadian General Electric Company, since their tender was the most satisfactory and advantageous. The 32 c.p. incandescent lamps were purchased from the Canadian Tungsten Lamp Company, Hamilton, after comparing their tender with others received.

Efforts were made to secure local contractors as far as possible in this work, but experience shows that work of this kind may be more economically performed on several installations under one contract, chiefly because of the elimination of a number of repetitions in buying, etc., which correspondingly reduce the first cost to all concerned.

Extensions were made to the lighting system as originally planned by the installation of lamps outside the building, located adjacent to the arrester gaps for their inspection and operation at night.

Water Cooling Systems.

Water pumps were required in each station for circulating the water for cooling the transformers. Specifications for these pumps were sent to all manufacturers in Canada as well as several in the United States, and on receipt of their tenders, after careful consideration, the contract was awarded for all pumps, with the exception of one, to the Canadian Buffalo Forge Co., of Montreal. These pumps were motor-driven turbine units, installed in duplicate.

A different type of pump was required in the St. Mary's station, and this was purchased from the Gould Pump Co. for \$326.00.

Oil Systems.

In order to facilitate the drying of the transformers, and also to ensure the exclusion of moisture, vacuum systems were installed in the various stations by which the air is exhausted from the transformers and oil drawn in from an intermediate tank described later. This necessitated the installation of a compressor. Small oil pumps and filters were also installed for purifying the oil.

Specifications relative to the installation of apparatus, piping and fittings were supplied all reputable contractors in the district, and after careful consideration of all tenders received, the contracts were awarded as follows:—

Niagara Falls Station, Purdy, Mansell, Toronto.....	\$1196 00
Dundas Station, Purdy, Mansell, Toronto	578 00
Toronto Station, Keith & Fitzsimons, Toronto	1035 00
London Station, Noble & Rich, London	872 00
Guelph Station, Keith & Fitzsimons, Toronto	640 00
Preston Station, Bernhardt & Giès, Preston	736 84
Berlin Station, Keith & Fitzsimons, Toronto	575 00
Stratford Station, Keith & Fitzsimons, Toronto	600 00
St. Mary's Station, Noble & Rich, London	700 00
Woodstock Station, Purdy, Mansell, Toronto	563 00
St. Thomas Station, Noble & Rich, London	700 00

The filters were supplied by the Canadian Westinghouse Co., the intermediate tanks by Edward Ramage, of Toronto.

Transfer Trucks.

Trucks designed for a track with an 18 ft. gauge are employed for transferring the transformers to and from the erection rooms at the various stations. The transformers at Niagara weigh approximately 45 tons, and at the other stations from 30 to 35 tons. Trucks were manufactured by the John Inglis Company.

Switches and Busses.

Compartments of brick or concrete were required as a protection for the 13,200 volt wiring, busbars and switches. Contracts covering the necessary work were awarded as follows:—

Niagara Falls Station, John Hayman & Sons, London. Included in Building Contract.	
Dundas Station, General Contracting Co., Toronto.....	\$526 00
Toronto Station, Built by the City of Toronto, we to pay our share of the cost.	
London Station, Hyatt Bros.	766 00
Guelph Station, General Contracting Co., Toronto	526 00
Preston Station, Edge & Gutteridge, Seaforth	850 00
Berlin Station, Edge & Gutteridge, Seaforth.....	875 00
Stratford Station, Edge & Gutteridge, Seaforth.....	420 00
St. Mary's Station, Edge & Gutteridge, Seaforth.....	420 00
Woodstock Station, General Contracting Co., Toronto....	850 00
St. Thomas Station, Edge & Gutteridge, Seaforth.....	420 00

Some additions have been made to the original plans for these structures; for instance, for the installation of a feeder switch for the Ontario Agricultural college at Guelph Station, it was not thought advisable to install complete bus structures, for irrespective of the number of actual feeders in use, the particular type of switch employed would materially alter the design of the structure proper.

Protection for Operators.

In addition to grounding all parts of the station and the towers on the station site, as previously referred to, attention in detail has been given to the complete grounding of all parts which the operators handle in ordinary operation. Screens and guards have also been placed at various points where the men are apt to come in contact with the high voltage equipment, and notices are posted forbidding the entrance of the public except under the careful guidance of the operators. Various other notices of warning have been posted about the site and inside the building.

Switching Equipment.

Requests for additional feeder switches at the Guelph, Stratford, St. Mary's, London and St. Thomas stations were received from several municipalities which increased the original contract with the Canadian General Electric Company, from \$372,545.00 as mentioned in Second Annual Report to \$425,549.63.

Station construction work on the original system was practically completed prior to October 31st, 1911. There are a few exceptions, i.e. small charges which will be made by the operating staff from time to time.

Buildings and Equipment.

Low Tension Conduit.

Power is received at the Niagara Falls Station from the Ontario Power Company's Distributing Station at a potential of 12,000 volts over three conductor, 300,000 cm., paper insulated, lead sheathed cables 2,200 ft. in length placed in tile conduits. Each cable has a carrying capacity of 4,500 kw., and since the individual transformer banks have a rating of 9,000 kw., two incoming power cables feeding these banks are connected in parallel. The ends of each pair of cables are protected by automatic oil circuit breakers connected to auxiliary busses, which in turn are connected by similar breakers to the main busses, or directly to banks of transformers as desired.

Niagara Falls Step-up Transformer Station.

At present, there are nine 3,000 kv-a. single phase transformers installed, although the building has been made sufficiently large to contain an additional bank of three.

From the high tension side of the transformers the current is carried through disconnecting switches, and high tension oil switches to the high tension busbars, here it passes again through disconnecting switches and oil circuit breakers to the line outlets of the two 110,000 outgoing lines, and thence through choke coils and passing electrolytic arresters, provided with horn gaps placed outside, on to the line.

The 12,000 volt switches, busbars and accessories are located in the basement, and incoming feeder cables are laid in ducts beneath the basement floor, the necessary number terminating at the terminal compartment opposite each feeder switch. The heating boilers, oil tanks, storage battery, pumps and air compressor are situated in other parts of the basement. The cables feeding the switches terminate in terminal rooms with standard end bells, above which the feeders are tied together in pairs. The leads from the transformer oil switches pass up through the

floor to the transformers, where the potential is stepped-up to 63,500 volts single phase. Each feeder is equipped with three oil circuit breakers, the first connecting the power source to an auxiliary bus, the second, the auxiliary bus to the main bus, and the third, the auxiliary bus to a bank of transformers. By this arrangement a feeder with a capacity equal to that of a transformer bank may be connected directly to a transformer bank or to the main bus. Through the medium of the auxiliary bus a transformer bank may also be connected to the main bus. This arrangement, while not complicated, offers sufficient flexibility to the circuit, since there are always two oil circuit breakers in series. The feeder switches are equipped with inverse time limit relays. Only the bus switches are non-automatic. Disconnecting switches are also supplied on each side of the oil switches, which are electrically controlled from a switchboard located in the control room, colored lights being employed to indicate the position of the switches.



Step-Up Transformer Station, Niagara Falls, Ont.

A service oil switch for controlling the transformers employed for the lighting, mechanical and other station equipment is connected to the main 12,000 volt bus.

All 12,000 volt connections, busbars and switches are enclosed in concrete cells.

The transformers and high tension switches are located on the main floor. Transformer banks are separated from each other by brick walls 25 feet high, and from the high tension switches by a brick wall 15 ft. in height. A track runway is provided to facilitate the removal of the transformers to the erection room for inspection or repairs. The piping subway is beneath the transformer compartments, and the oil, water and air pipes pass through the floor immediately in the rear of the transformers to the piping mains. The transformers are connected in delta on the low tension, in star on the high tension sides, and have grounded neutrals through a water resistance. The nine 3,000 kv-a. transformers are shell

type, oil insulated, water cooled, and designed for operation at a potential of 12,000 volts low tension, and 110,000 volts high tension. They are equipped with the Westinghouse condenser type of bushing.

The transformers and high tension lines are connected to the busses by automatic three-pole oil circuit breakers, operated from the control gallery in a manner similar to the 12,000 volt oil switches. In general the oil switches are isolated by means of disconnecting switches with blades normally vertical, mounted on post insulators, supported on the walls. All 110,000 volt connections and busses consist of bare one-inch seamless copper tubing installed near the roof and supported on porcelain petticoat insulators, of the built-up post type, with an overall height of 39 inches, in turn secured to special steel structures. These busses extend the entire length of the high tension switch room, and have a minimum clearance of 6 ft. between phases and 3 ft. 6 in. between a conductor and ground. The five 110,000 volt three-pole circuit breakers are electrically operated, and equipped with Westinghouse condenser type bushings. Due to the design of these switches no concrete barriers or brick work are required, and the switches proper will automatically open by gravity should accidents occur to their mechanisms.

The line outlets consist of corrugated porcelain tubes 40 in. long, supported in a horizontal position by four porcelain posts mounted in the plane of the wall in a treated wooden frame five feet square, and having the intervening space filled with plate glass.

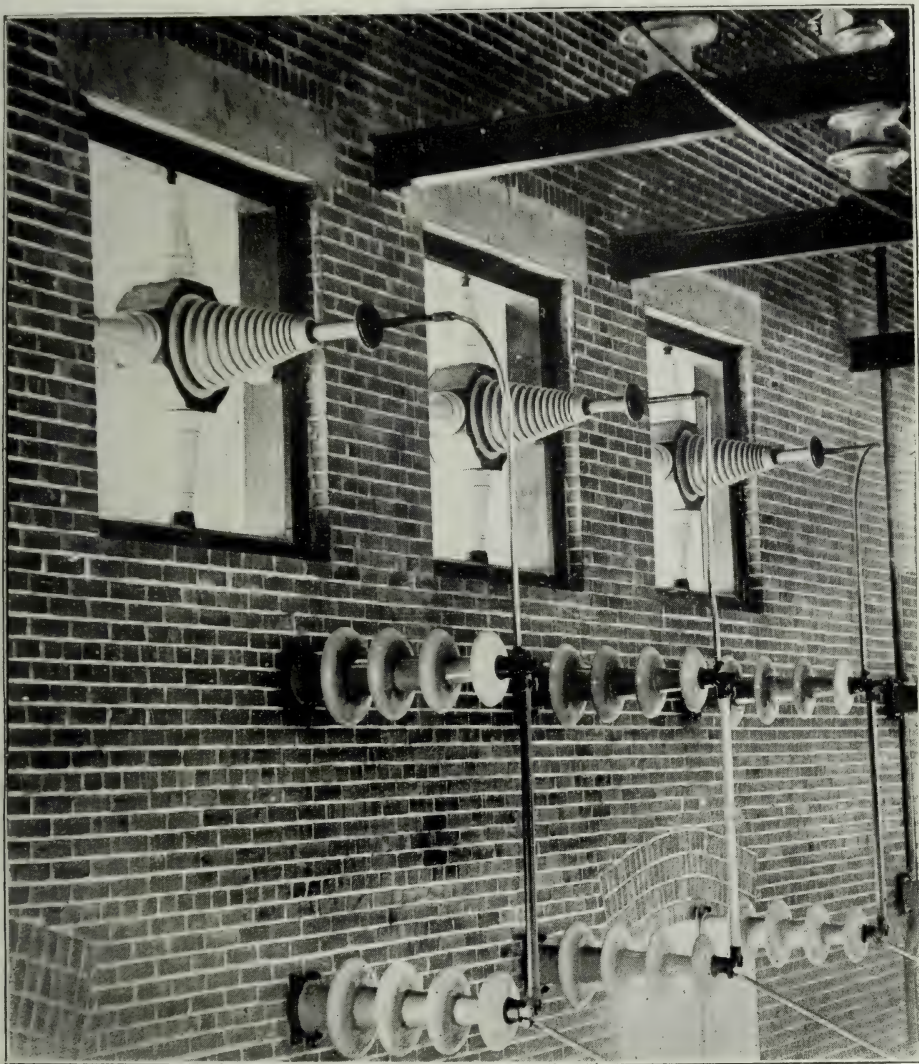
The hoods protecting the outlet bushings from the weather are 8 feet wide and extend three feet below the level of the bushing. On leaving the porcelain the leads drop vertically to a post insulator beneath the hood from the top of which the cable is carried directly to the insulator on the arrester structure. Beneath the wall outlet and this insulator is placed a choke coil constructed of aluminum wire in the shape of a helix with porcelain separators between the adjacent turns.

Lightning protection is secured by two sets of electrolytic lightning arresters, one for each outgoing line, equipped with horn gaps and placed on special steel structures outside the building. The aluminum plates set in boiler iron tanks filled with oil.

Two switchboards are installed in the control room. The main board consists of three 28-inch slate panels, each panel controlling one incoming feeder, the two connected 12,000 volt switches and one transformer bank. Two of the panels, in addition, control the outgoing high tension lines. Mimic bus connections, and the indicating lamps on the board assist the operator. The recording meters are placed on panels in the rear of the main board. The second switchboard is used for station service only, and controls the lighting, motor generator, for battery charging, crane, and pump circuits. Incandescent lamps are used for lighting. Every third lamp is wired in such a manner that by means of a no voltage release switch on the service switchboard these lamps may be quickly thrown over to the battery circuit in case alternating current energy is off.

The water employed for cooling the transformers is obtained from the City of Niagara Falls, or should the City supply fail, from the Ontario Power Company. The water after passing through the transformer coils is carried to a sprinkling cooling tank, which is an open concrete basin, 6 ft. in depth, in two sections, each 30 by 60 ft. with the top just above the ground level. The water is delivered to the basin through sprinklers designed to reduce the temperature of the water, and located some distance above the surface. Duplicate motor driven pumps are installed for operating this system. The duplicate oil tanks are also installed in the

basement, the capacity of each is slightly greater than the oil capacity of one transformer. The transformers are provided at their tops with oil blow-offs piped to a main, running into the "bad" oil tank, which is provided with an oil sealed blow-off to a sewer and a valve at the bottom for draining purposes. Oil filters and dryers are installed between the tanks, and the oil, after being filtered, is pumped back into the "good" oil tank. An oil pump is also provided for pumping pure

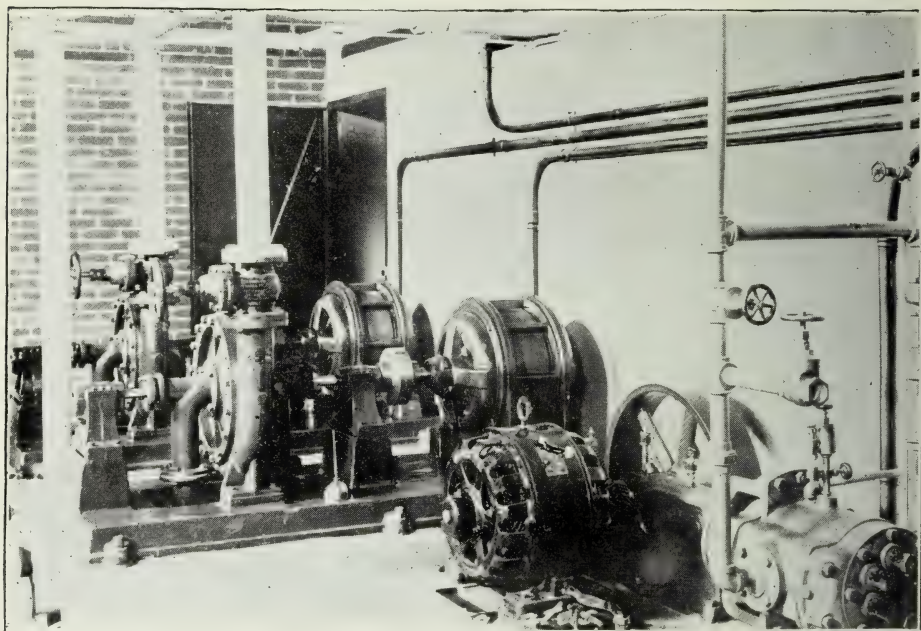


High Tension Outlets, Niagara Falls Station.

treated oil to an "intermediate" oil tank placed on the main floor at an elevation that permits the oil to be drawn into any of the transformers by exhausting the air from the cases by a specially installed motor driven air compressor and vacuum pump. This equipment may be operated as a vacuum pump for drawing oil into the case, or as a compressor for pumping in air to assist gravity in emptying it. The high tension oil switch tanks are connected by pipes to a switch oil tank in the basement, and this in turn is connected to the oil filter.

All stations in the system are equipped with similar oil and air circulating systems. The water system is varied in the different stations to suit local conditions, but in such case duplicate pumps are provided unless the station is connected to the local mains. The erection room is located near the end of the building, and contains a 45 ton travelling crane, with electric hoist, hand bridge and trolley travels. The control room is situated near the erection room in an enclosed gallery overlooking high tension switch and erection rooms. From this gallery the operator has an unobstructed view of the erection and high tension switch rooms. Eventually, the erection and control rooms will be located in the centre of the building, 344 ft. long by 50 ft. wide.

The high tension switch room extends along one side of the building, contains all the high tension transformer lines, disconnecting switches and high tension busbars.



Motor Driven Compressor and Pumps, Niagara Falls Station.

Dundas Interswitching Station.

The Dundas Station is the main interswitching station of the Niagara system, and from here the outgoing transmission lines radiate to the various sub-stations.

The station equipment consists of four 750 kv-a. oil insulated, water-cooled 110,000 to 13,200 volts, Westinghouse step-down transformers, employed to supply the City of Hamilton and vicinity; seven 110,000 volt Westinghouse electrically operated circuit-breakers equipped with condenser type bushings; six sets of outdoor type, 110,000 volt, electrolytic lighting arresters and two sets of 13,200 volt, electrolytic lighting arresters.

Seven 110,000 volt, 3 pole automatic solenoid operated oil switches, one for each incoming and outgoing line and one for each bank of three 750 kv-a. transformers are also installed. Two sets of 110,000 volt busses are supported on horizontal I beams near the roof, in a manner similar to those at the Niagara Falls

Station. Disconnecting switches are provided on the line side of the oil switches, while on the station side two sets are installed and so arranged that any of the lines may be connected to either set of busses.

The same method of installing and removing transformers is employed as at Niagara. In fact, the same arrangement is used in all stations in the system. The transformers are connected star delta with low tension winding potential of 13,200 volts. A spare transformer is provided to replace the transformers of the connected bank, in case any of them become disabled.

The 13,200 volt switches and busbars are enclosed in concrete cells. The present structures accommodate the transformer switch, two line switches, and the service transformer switch. They are all automatic, electrically controlled oil switches, each provided with relays best suited for the requirements of the service for which they are employed. Service transformers are provided to supply light



Interswitching Station, Dundas, Ont.

and power to the station. Three oil insulated, self cooled, 75 kv-a. transformers, stepping down from 13,200 to 2,200 volts serve the Town of Dundas.

The apparatus in the station is operated from an enclosed control room situated at one end of the high tension switch room, in which are located the main control and service boards, similar to those at Niagara. The control switchboard carries all the control switches operating at 110 volt d.c. for the remote control of the high and low tension power switches, and also the meters. The service board is a regular switchboard employed to distribute the power to the different lighting and power circuits in the station.

The mechanical and cooling equipment in general is the same as in the step-up station.

Condenser bushings are used in both the Niagara Falls and the Dundas Stations on all high tension switches and transformers. The Canadian Westing-

house Company furnished and installed the entire equipment, with a few exceptions, of these two stations. Arrangements are being made at the present time for the installation of an additional bank of transformers and the necessary switches.

Toronto Station.

This station was built in three sections, each running the length of the building, and consisting of the high tension switching, the transformer, and the low tension switching sections.

The incoming lines are protected by electrolytic arresters, placed within the building, and provided with horn gaps mounted on steel structures outside. The hoods for the outlets are built with a floor, upon which the entrance bushings consisting of stacked porcelain rings with a pronounced petticoat are mounted. The different sections of the bushings are clamped together with a brass bolt extending through the centres, the intervening spaces between the brass and porcelain being filled with concentric fibre rings and insulating compound. Since the arresters are placed inside and the horn gaps outside the building, six bushings are required for each line. Spiral choke coils are employed and are inserted in the power lead on the inner side of the entrances.

The 110,000 volt oil switch equipment consists of two line and two transformer switches, each in the busbar circuits. The general arrangement of 110,000 volt busses and connections are similar to those at Niagara Falls and Dundas, with the exception that the insulators used are of a corrugated rather than a petticoated type. General Electric oil switches and transformers are employed and provided with bushings built of annular sections of compound clamped together, the interior space being filled with concentric cylinders of treated fibre compound.

The transformer equipment consists of two banks of 1,250 kv-a. transformers stepping down the transmission voltage to 13,200 volts. The low tension leads branch and run through the oil switches to two sets of busses, each of which is divided into two parts. The cell work is built with pressed brick walls and concrete shelves. Ultimately, two ring busses will be installed, each being in four sections. There are eight feeders, each provided with automatic oil switches for connecting to either set of busses in use at the present time. The oil switches and busses are located in two rows on a gallery, while the potential and series transformers are placed in compartments on the main floor immediately beneath the switches. The busses are protected by aluminum cell surge protector sets. The outgoing feeders leave the building by underground ducts and connect with the five municipal substations in different parts of the city located and connected in a loop.

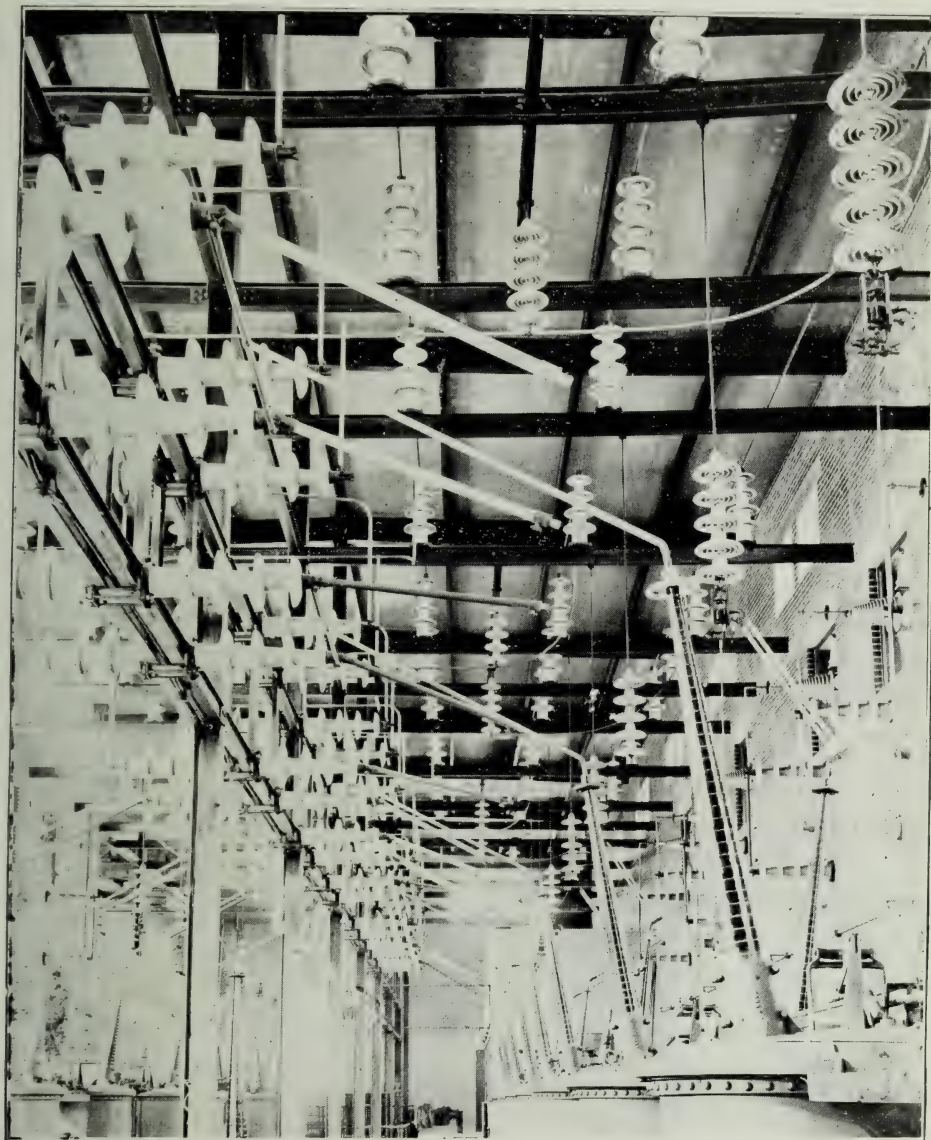
The City of Toronto is at present installing transformers stepping down from 13,200 to 2,200 volts in the basement of the station, which will be used for City service, mainly to supply energy for the factory load of the city, a large part of which is located within one half mile of the station.

The control switchboard is located on a small gallery. All 110,000 and 13,200 volt switches are operated from the board. Curve drawing meters are mounted on the feeder panel for recording both the load and power factors.

A concrete pump-house has been constructed a few hundred yards distant on the shore of Lake Ontario with an intake pipe extending 500 ft. into the lake to provide cold water for cooling purposes. Duplicate motor driven pumps and a service equipment similar to that at the Niagara Falls Station have been installed.

Guelph, Preston, Berlin, St. Marys and Woodstock Stations.

The 110,000 volt equipment in each of these stations is similar, since they are loop stations. The lines enter the stations through automatic oil switches to the busses, and pass through similar circuit breakers. The incoming and outgoing lines in each station are provided with electrolytic arresters. The transformers



High Tension Interswitching Room, Dundas Station.

are supplied with current at high potential, from the busses through automatic oil switches. Disconnecting switches are installed on either side of the oil switches, except on the transformer side of the transformer oil switch.

Each station is equipped with a bank of three single-phase 750 kv-a. oil insulated, water-cooled transformers and also a spare unit available for use in case of

an emergency. The low tension winding potential is 13,200 in every case with the exception of Preston, where the greatest transmission distance is only six miles, and 6,600 volts potential was adopted for distributing purposes. All transformers are supplied with taps for both 6,600 and 13,200 volts.

The low tension equipment is similar, and the general arrangement the same in all stations, the only difference being in the number of outgoing feeders. All feeders are equipped with automatic, hand-operated oil switches, disconnecting switches, switchboard panels containing indication and recording meters, relays and handles for operating the switches, and protected by electrolytic lightning arresters.

Provisions were made for six outgoing feeders at each of the present stations. Preston, Berlin and Woodstock are now utilizing their full complement of feeders.

The service equipments both electrical and mechanical are in general the same as those employed in the stations previously described, except that no storage batteries or motor generator sets are required because the switches are hand-operated. Duplicate water pumps are provided to circulate the water employed to cool the transformers except in instances where city water service has been secured.

The spare transformers in any of these as well as in London and St. Thomas stations may be quickly connected in a bank in place of a disabled one.

London Station.

This station is a "Loop" station with a branch line running off the main bus. The high tension equipment is practically the same as that in the other "loop" stations just mentioned, with the addition of an oil switch connecting the busses and line supplying St. Thomas. There are four 110,000 volt and six 13,200 volt electrically operated oil switches, and three 1,250 kv-a. transformers installed in the station. A spare transformer is also provided for use in case of emergency. Four 13,200 volt feeders supply energy to the City of London's distributing station and to the Provincial Asylum.

St. Thomas Station.

This station will ultimately be a "loop" station, although it is a terminal station at the present time, and consequently has no 110,000 volt outgoing line equipment. The building, however, is constructed similar to the other standard "loop" stations.

PORT CREDIT SUB-STATION AND MISCELLANEOUS.

As soon as the contract with the Port Credit Brick Company negotiated during the Spring of 1911 was closed, tenders were called for, contracts placed for electrical equipment, and the construction of the station building started.

Specifications for the electrical equipment were forwarded to the principal electrical construction companies in Canada, Europe and the United States on May 6th, 1910.

Contracts for this equipment were awarded as follows:—

September 13th, 1910, to the Canadian Westinghouse Company for Switching and Protective Apparatus—\$29,792.00.

The following is a copy of an Agreement for the supply and erection of Switching and Protective Apparatus.

THIS AGREEMENT made this 13th day of September, A. D. 1910.

Between:

CANADIAN WESTINGHOUSE COMPANY, LIMITED, OF HAMILTON,
hereinafter called the "Contractors."

Party of the First Part.

— and —

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter
called the "Commission"

Party of the Second Part.

WITNESSETH, that the parties covenant, promise, and agree each with the other as follows:—

1. In this contract the word "Work" or "Works" shall unless the context requires a different meaning, mean the whole of the Work or Works, and material, matters and things required to be done, furnished and performed by the Contractor under this contract. The word "Engineer" shall mean the Chief Engineer for the time being appointed by the Commission and having control over the Work or Works.

2. Wherever in this agreement the Contractor or Commission are mentioned or referred to, such mention or reference shall extend to, and be binding upon the heirs, executors, administrators, successors or assigns of the aid parties respectively:

3. The following Documents:

(a) Commission's Specifications for Electrical Equipment (Switching and Protective) Port Credit Station, with attached Instructions to Bidders and Form of Tender marked "A" (36 pages and 2 prints).

(b) General conditions of contract (11 pages) marked "B".

(c) Contractors' proposal marked "C" which shall take precedence over Commission's Specifications (5 pages).

(d) Prints and Contractors' Drawings when initialed as approved by Engineer, marked "D".

(e) Contractors' Bond marked "E".

Shall be read into and form part of this contract. Should any of the above documents contain contradictory clauses, the preference shall be given to the documents in the order given above, unless otherwise stated.

4. Contractors covenant and agree:

(a) To supply all necessary material, labor, tools, machinery and other plant, required for the construction, delivery, installation and test of the switching and protective electrical equipment for the Commission's Transformer Station near Port Credit, Ontario, as set forth in detail in specifications and exhibits hereto.

(b) To use the best material, and construct, complete and install, and test the said work, in a thorough and workmanlike manner and in strict conformity with said specifications and drawings except as amended by clauses herein, to the satisfaction of the Commission's Chief Engineer, for the sum of twenty-nine thousand, seven hundred and ninety-two dollars (\$29,792.00).

(c) To fully complete, test, and deliver to the Commission, the switching and protective apparatus, ready for supplying existing demand six months from receipt of contract executed by the Commission and of the Engineer's order to proceed with all work, provided the Commission shall have the station under cover and ready for commencing and continuing installation of apparatus not later than December 1st, 1910.

5. It is understood that the Contractors will perform a double potential test on all apparatus covered by contract, the Commission to allow the Contractor the use of one of the 110,000 volt lines from Dundas to Port Credit for this purpose. The time of tests to be determined by the Engineer.

6. The contractor to deliver to the Commission a bond satisfactory to the Commission to secure the sum of seven thousand, five hundred dollars (\$7,500.00) for the proper performance of this contract. It shall be provided in said Bond that without notice to the surety, the said documents in this contract or any part or parts thereof may from time to time be varied, and that the said sureties shall not be released, or the liability under the Bond affected by any such variation.

7. The Commission agrees:

(a) The Engineers shall pursuant to Paragraph 7 of General Conditions, give his order to the Contractors to proceed with the work immediately.

(b) To pay the Contractors for said equipment and Works upon the terms and conditions set forth in said General Conditions, and Specifications, and upon the terms particularly mentioned in paragraph No. 4 (b).

8. It is further agreed:

(a) That the 110,000 volt lightning arresters shall be placed outside the building as recommended by the Contractor. Necessary supports for same to be provided by the Contractor at his expense, with the exception of concrete foundations, which are to be supplied by the Commission.

(b) The Contractor shall immediately prepare drawings showing the arrangement of all apparatus covered by contract, and will submit same to the Engineer for approval, on or before October 15, 1910, and Contractor shall supply Engineer with all data relative to tests and construction as required. Upon the execution of the contract by the Contractor, the Engineer will furnish the Contractor with a set of blue prints from which the Transformer Station building will be constructed. No material not shown on these drawings will be furnished by the Commission.

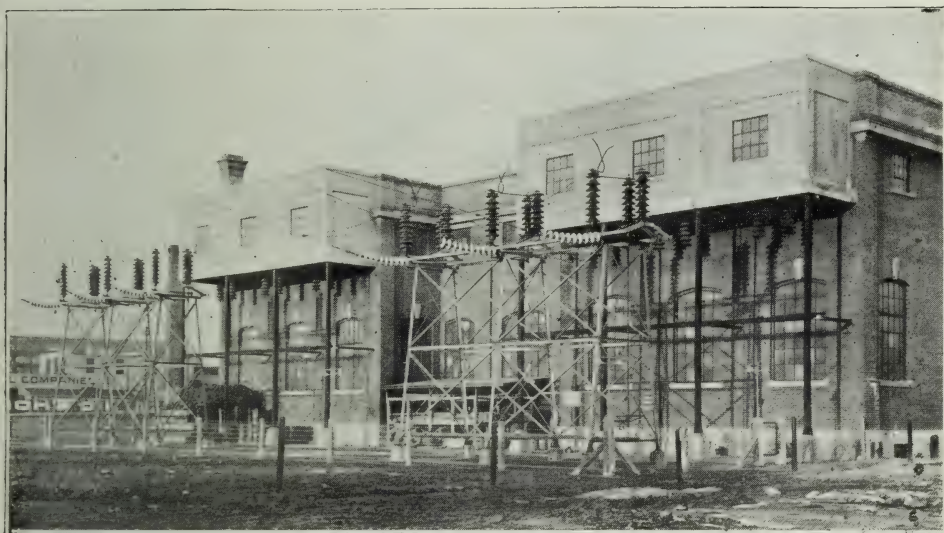
(c) That should the Engineer not accept any apparatus supplied by Contractor under agreement dated 26th May, 1909, then this rejection shall likewise apply to similar apparatus supplied under this agreement.

(d) If the Contractor does not in the opinion of the said Engineer, carry on the works with sufficient speed to complete the work on said date, the Commission may, at its option, be released from this agreement, and the Contractor shall, upon notice

in writing, immediately discontinue the works, and if required by the said Engineer, the Contractor shall immediately remove the whole or any part of the said equipment, to be specified by the Engineer, that has been delivered to the Transformer Station and the Commission may, at the option, proceed with the said works. The Commission shall not be liable for any loss, costs or damages arising before or after the release of the Commission from this agreement.

(e) All rights and remedies of the Commission and of the Engineer, noting on their behalf, may be exercised and continued concurrently or in the alternative.

(f) If within twelve months from date of the final certificate of the Engineer, it appears that unsound or defective material has been used by the Contractor, or the said works have not been executed in a substantial, workmanlike, and proper manner, the Contractor shall be liable to the Commission for all damages arising therefrom. No certificate, payment, or other act, matter or thing done or omitted under the contract, shall bar or prejudice the rights of the Commission in this respect.



Toronto Station.

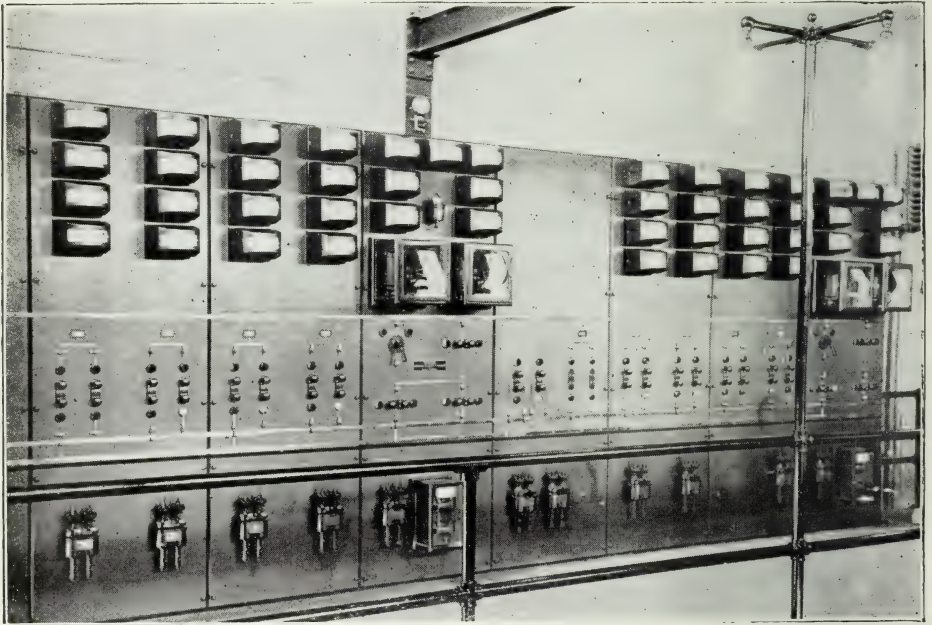
(g) Time shall be of the essence of this agreement.

(h) For all purposes of this contract, notices shall be served upon the Engineer, or his appointee in writing to the Commission, and upon the manager, or his appointee in writing for the Contractor.

(i) In case any municipal corporation which has or shall contract with the Commission for a supply of power, or any person, firm or corporation, which has or shall contract with any such municipal corporation, or with the Commission, for a supply of power, shall suffer damages by breach of this contract by the Contractor, and such municipal corporation, firm, person, or corporation, would, if the Contractor had made this contract directly with them, have had a right to recover such damages, or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings, or bring such action for, or on behalf of, such municipal corporation, person, firm, or corporation, and notwithstanding any acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such municipal corporations, person, firm, or corporation,

including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation, firm, person, or corporation, shall have agreed with the Commission to pay any costs that may be adjusted to be paid. The rights and remedies of any such municipal corporation, person, firm or corporation, shall not be hereby prejudiced.

9. The Contractor shall not be liable for damages for breach of contract caused by any delay of the Commission, and neither party shall be liable for damage for breach of contract caused by strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war, the delay of any other contractor, or any other cause reasonably beyond its control, and should any delay in the performance of this contract be caused to either party thereby, the Contractor shall not be bound to deliver, and the Commission shall not be bound to accept equipment during such time, and the time for performance of this contract by both parties shall be correspondingly extended.



High Tension Switchboard, Toronto Station.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption, in so far as they are able, and when such interruption shall have ceased the parties shall be prompt and diligent to perform the contract.

Provided that in construing this paragraph the rule of law known as "ejusdem generis" shall not be applied.

10. (a) If any difference shall arise during the progress or after the completion of the works, as to any matter or thing arising under or out of this contract, such difference may upon completion of the work be referred to two arbitrators not to be chosen by each of the parties hereto, and they shall choose a third arbitrator; but, if they cannot agree, such third arbitrator shall be chosen by the Chief Justice at the time of the King's Bench Division of the High Court of Justice. When possible, the arbitrators shall decide such difference in a summary manner. Either

party may appeal from any award of the arbitrators, as provided by the Arbitration Act Ont. Stat. 1909, Chap. 35, but no such appeal shall be carried beyond the decision of the Court of Appeal of Ontario.

(b) The arbitrators shall not consider any matter or difference which is expressly, or by implication, required, or permitted to be decided by the Engineer, or as to the grounds upon which, or mode in which, any opinion may have been formed or discretion exercised, by the Engineer. If any such matter or difference shall arise, and the Contractor claims that such matter or difference should be determined by arbitrators, the Contractor may apply in writing to the Commission to waive this paragraph 10 (b); thereupon the Commission shall appoint a time and place to hear any representations of the Engineer or Contractor, and the Commission may, in its sole discretion, waive the provisions of the paragraph 10 (b), and permit the said matter or difference to be referred under paragraph 10 (a) to said arbitrators.

This agreement shall extend to, and be binding upon, and enure to the benefit of the successors, and assigns of the said parties.

IN WITNESS WHEREOF the Commission and the Contractors have respectively affixed their Corporate Seals and the hands of their proper officers.

DELIVERED
SIGNED, SEALED AND

in the presence of

[SEAL.]

[SEAL.]

CANADIAN WESTINGHOUSE
COMPANY LIMITED OF HAM-
ILTON.

(Sgd.) F. A. MERRICK, Acting
Vice-Pres.

Atest.

(Sgd.) J. M. H. KERR, *Secretary.*

HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

(Sgd.) A. BECK, *Chairman.*

(Sgd.) W. K. McNAUGHT.

(Sgd.) W. W. POPE, *Secretary.*

September 20th, 1910. To the Allis Chalmers Bullock Co., for transformers \$26,160.00.

During the spring of 1911, a fire occurred at the works of the last mentioned company, which destroyed the transformers in course of construction and so crippled the plant that they were unable to supply new transformers within a reasonable time. As the contracted delivery date was over due when the fire occurred this company was relieved of its contract, and negotiations opened with the Canadian Westinghouse Company and the Canadian General Electric Company with the result that a contract was entered into with the latter firm for the supply of four 1,250 kv-a transformers at a price of \$28,000.00. Shipment was required and stipulated in ten weeks. The equipment is now being installed and will be placed in operation during the month of November 1911.

The following is a copy of agreement for the supply and erection of transformers:—

THIS INDENTURE made this 19th day of July, A.D. 1911.

BETWEEN :

THE CANADIAN GENERAL ELECTRIC COMPANY, LIMITED,
hereinafter called "Contractor,"

of the First Part,

and

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, herein-
after called the "Commission,"

of the Second Part.

WITNESSETH that in consideration of the Covenants and agreements on the part of the Commission hereinafter contained, the Contractor covenants and agrees with the Commission as follows:—

1. In this contract the word "work" or "works" shall, unless the context require a different meaning, mean the whole of the work performed by the Contractor under this contract. The word "Engineer" shall mean the chief engineer for the time being appointed by the Commission and having control of the works.

2. Wherever in this Indenture the Contractor or Commission mentioned or referred to such mention or reference shall extend to and be binding upon the executors, administrators, successors and assigns of the said parties respectively.

The following Documents:

(a) The Contractor's proposal No. 12658 (a), three pages, hereto attached, Marked "A."

(b) The agreement between the Contractor and the Commission bearing date the 26th day of May, A.D. 1909, so far as the same is applicable to this Contract shall be read with and form part of this Contract.

The Contractor agrees:

(a) To furnish, test, deliver free of duty, freight or other charges, and instal (4) 1,250 kv-a. transformers in the Commission's Transformer Station near Port Credit in the Province of Ontario, in all respects as set forth in detail in the attached proposal and specifications.

(b) To use the best material, and construct, instal and equip the said work in a thorough workmanlike manner in strict conformity with said proposal, specifications and exhibits set out herein to the satisfaction of the Commission's Chief Engineer.

(c) To ship the said four transformers and material from Pittsfield, Massachusetts, on or before the 5th day of August, 1911, and to use every means in its power to hasten the delivery of the said transformers at Port Credit Transformer Station, and will forthwith after the arrival at said station commence installation and carry on the erection and completion of the work with all possible dispatch.

(d) That the terms and conditions of the agreement between the Contractor and the Commission, bearing date the 26th day of May, 1909, aforesaid, in so far as they apply hereto, and are not modified or superseded by Clauses herein, shall be read with and form part of this Contract as fully as if set out in full herein.

(e) That the Commission may perform tests after the erection and installation of said transformers similar to those performed and to be performed by the Contractor on the transformers supplied by the Contractor under the said agreement of 26th of May, 1909, said tests to be performed in the presence of the Contractor, their agent or representative.

(f) That said transformers when so installed and tested shall withstand successfully the test referred in the above Clause.

The Commission agrees:

(g) To pay the Contractor for the work and equipment herein specified when so installed, tested and approved, as aforesaid, the sum of Twenty-eight Thousand Dollars (\$28,000.00).

IN WITNESS WHEREOF the Commission and the Contractor have respectively affixed their Corporate Seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

(Sgd.) B. Haddy.

[SEAL.]

[SEAL.]

{ CANADIAN GENERAL ELECTRIC
COMPANY, LIMITED.

{ (Sgd.) A. E. GUEST, *Treasurer*.

{ HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

{ (Sgd.) A. BECK, *Chairman*.

{ (Sgd.) W. W. POPE, *Secretary*.

Tenders were called for the station on August 13th, 1910, and a contract was closed for the building proper with Stewart Bros. of Port Credit on September 2nd, for \$14,875, and with the Jenks Dresser Company, of Sarnia, for the steel work on September 17th, for \$4,650.00. In February 1911, it was found that the former would be unable to complete the contract satisfactorily. A mutual agreement was made and the work taken over by the Commission and completed.

The following is a copy of agreement for construction of substation building (not including steelwork).

THIS AGREEMENT made this 20th day of September, A.D. 1910.

BETWEEN:

WILLIAM STEWART, and ROBERT STEWART, trading as STEWART BROTHERS, OF PORT CREDIT, Province of Ontario, hereinafter called the "Contractors,"

parties of the First Part.

and

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter called the "Commission"

parties of the Second Part.

WITNESSETH, that in consideration of the covenants and agreements on the part of the Commission hereinafter contained, the Contractors hereby covenant and agree with the Commission as follows:—

1. In this contract the word "Work" or "Works" shall, unless the context requires a different meaning, mean the whole of the Work or Works, and material, matters and things required to be done, furnished and performed by the Contractor under this Contract. The word "Engineer" shall mean the Chief Engineer for the time being appointed by the Commission and having control over the Work or Works.

2. Wherever in this agreement the Contractors or Commission are mentioned or referred to, such mention or reference shall extend to, and be binding upon the heirs, executors, administrators, successors, or assigns of the said parties respectively.

(a) Commission's Specifications for Construction of Transformer Station near Port Credit, Ontario, with attached instructions to Bidders and form of Tender, together with the following Drawings:

2-S-13003—Port Credit Station Site—Dated August 5th, 1910

4-S-13013—Plan of Foundations—Dated August 30th, 1910.

4-S-13015—Plan of Main floor and gallery—Dated August 29th, 1910.

4-S-13016—End Elevations—Dated August 30th, 1910.

4-S-13017—Front and Rear Elevations—Dated August 30th, 1910.

4-S-13018—Steel Diagrams—Dated August 30th, 1910.

4-S-13010—Wall Detail—Dated August 31st, 1910.

4-S-13020—Longitude section—Dated August 31st, 1910.

4-S-13021—Roof Plan—Dated August 31st, 1910.

4-S-13022—Cross Sections—Dated August 31st, 1910.

(b) General Specifications for Materials, etc. (26 pages) marked "B."

(c) General Conditions of Contract (11 pages) marked "C."

(d) Contractor's Bond.

Shall be read into and form part of this contract. Should any of the above documents contain contradictory clauses, the preference shall be given to the documents in the order given above, unless otherwise noted.

4. Contractors covenant and agree:

(a) To supply all necessary material, labor, tools, machinery and other plant, required for the construction, complete in every respect in strict accordance with

specifications and drawings, or as they may be amended from time to time, with the exception of steel work provided for in section 23 (Steel Work Alternative) the Commission's Transformer Station near Port Credit, Ontario.

(b) To use the best material, and complete said work in a thorough, substantial and workmanlike manner, in strict accordance with Drawings, Exhibits, and Specifications, upon dates and manner hereinafter provided, to the entire satisfaction of Commission's Chief Engineer, for the sum of Fourteen Thousand, Eight Hundred and Seventy-five Dollars (\$14,875.00).

(c) To have bearing stones for the support of Roof Trusses permanently set, on or before November 1st, 1910.

(d) To have the Station Building permanently enclosed on or before December 7th, 1910, providing steel trusses and roof purlines are completed by Commission as stated in paragraph 5.



Preston Station.

(e) To have all floors with the exception of gallery floor completed on or before January 1st, 1911, provided steelwork done by Commission as herein agreed.

(f) All other work and building completed on or before the First day of February, 1911, provided steel work done by Commission as herein agreed.

(g) To do all necessary grubbing, including removal and disposal of all stumps in the area agreed upon between the Contractors and Commission, to the satisfaction of the Chief Engineer, for which the sum of One Hundred Dollars (\$100.00) is included in amount stated in paragraph 4 (b) above. It being understood, that if any of the stumps have already been removed, a pro rata deduction to be made from the amount.

(h) Should the Commission require the hood columns encased in concrete, the same shall be done by the Contractor, as directed by the Chief Engineer, for which he shall be paid an additional sum of Thirty Dollars (\$30.00).

(i) Time shall be deemed to be the material and essence of this contract.

(j) Not to assign this contract without the written consent of the Commission.

(k) To deliver to the Commission a Bond satisfactory to the Commission to secure the sum of Three Thousand Seven Hundred and Twenty Dollars (\$3,720.00) for the proper performance of this contract. It shall be provided in said Bond that without notice to the surety the said documents and this contract, or any part thereof, may from time to time be varied, and that the said surety shall not be released, or the liability under the bond affected by any such variation. Premium \$75.00 on said Bonds to be paid by Commission.

5. The Commission agrees:

(a) The Engineer shall, pursuant to paragraph 7 of General Conditions of Contract, give his order to the Contractor to proceed with the work or works herewith immediately.

(b) To pay the Contractors for said work the sum of Fourteen Thousand, Eight Hundred and Seventy-five Dollars, with the additional sum set out in paragraph 4 (h) if the additional construction is required, at times, and in manner set out in specifications.

(c) To have steel trusses and roof purlins erected and riveted in said building by November 15th, 1910, provided that bearing stones for support of trusses are set by the Contractor, as provided for in paragraph No. 4 (c),

(d) All other steel work to be completed by December 15th, 1910.

6. It is further agreed:

(a) That Commission's Chief Engineer shall be the sole judge as to whether the said contract has been completed and the work or works done in accordance with specifications and drawings attached hereto, and no payment certificate, or other Act, matter or thing, done or omitted under this contract shall bar or prejudice the right of the Commission in this respect.

(b) If the Contractors do not in the opinion of the Engineer carry on the works with sufficient speed to complete the work on said dates, the Commission may at its option be released from this agreement, and the Contractors shall upon notice in writing, immediately discontinue the works, and if required by said Engineer, the Contractor shall immediately remove the whole or any part of the said equipment, works or material, to be specified by the Engineer, that has been delivered to the Commission and the Commission may at its option proceed with the said works. The Commission shall not be liable for any loss, costs, or damages arising before or after the release of the Commission from this agreement.

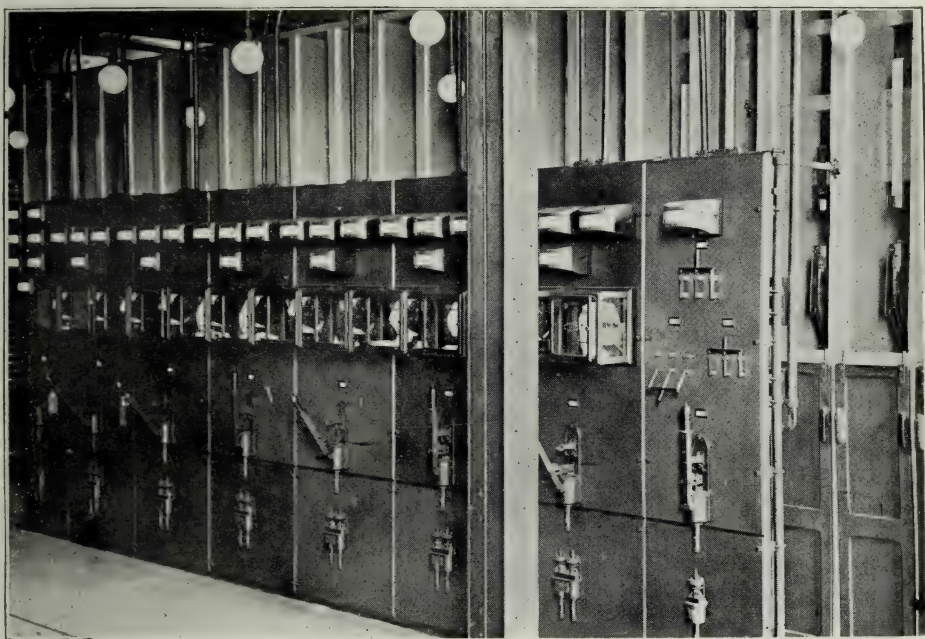
(c) All the rights and remedies of the Commission and of the Engineer, acting on their behalf, may be exercised and continued concurrently or in the alternative.

(d) If within twelve months from the date of the final certificate of the Engineer it appears that unsound or defective material has been used by the Contractors, or the said works have not been executed in a substantial, proper, and workmanlike manner, the Contractors shall be liable to the Commission for all damages arising therefrom. No certificate, payment, or other act, matter or thing, done or omitted under this contract shall bar or prejudice the right of the Commission in this respect.

(e) In case the Corporation of the Town of Brampton, or any other person, firm or Corporation, which has or shall contract with the Commission for a supply of power, or any person, or company which has or shall contract for the supply or erection of steel work, or electrical or other appliances for said transformer station, shall suffer damages by breach of this contract by the Contractor, and such municipal corporation, firm, person, or corporation would, if the Contractor had made

this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for, or on behalf of, such municipal corporation, person, firm or corporation, and notwithstanding any acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such municipal corporation, person, firm or corporation, including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation, person, firm or corporation, shall have agreed with the Commission to pay any costs that may be adjudged to be paid. The rights and remedies of any such municipal corporation, person, firm, or corporation shall not be hereby prejudiced.

7. Neither party shall be liable for damages for breach of contract caused by



Switchboard, Preston Station.

strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war, or any other cause, reasonably beyond its control, and should any delay be in the performance of this contract be caused to either party thereby, the contractors shall not be bound to deliver or the Commission shall not be bound to deliver, or the Commission shall not be bound to accept the work or works or material during such time, and the time for performance of this contract by both parties shall be correspondingly extended.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption in so far as they are able, and when such interruption shall have ceased, the parties shall be prompt and diligent to perform the contract.

Provided, that in construing this paragraph the doctrine of "ejusdem generis" shall not be applied.

8. If any differences shall arise during the progress or after the completion of the work, as to any matter or thing arising under or out of this contract, such difference or differences shall when the work is completed, be referred to two arbitrators, one to be chosen by each of the parties hereto, and they shall choose the third arbitrator, but if they cannot agree, such third arbitrator shall be chosen by the Chief Justice at the time of the King's Bench Division of the High Court of Justice. When possible the arbitrators shall decide such difference in a summary manner. Either party may appeal from any award of the arbitrators, as provided by the Arbitration Act, Ontario Statutes 1909, Chapter 35, but no such appeal shall be carried beyond the decision of the Court of Appeal of Ontario.

(b) The arbitrators shall not consider any matter or difference which is expressly or by implication required or permitted to be decided by the Engineer, or as to the grounds upon which, or mode in which, any opinion may have been formed, or discretion exercised by the Engineer. If any such matter or difference shall arise, and the Contractors claim that such matter or difference should be determined by arbitrators, the Contractors may apply in writing to the Commission to waive this paragraph 8 (b) and permit the said matter or difference to be referred under paragraph 8 (a) to said arbitrators.

This agreement shall extend to, and be binding upon, and enure to the benefit of the heirs, executors, administrators, successors, and assigns of the said parties respectively.

IN WITNESS WHEREOF the Commission and the Contractors have respectively affixed their corporate seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

WITNESS:

(Sgd.) K. M. EVANS.

(Seal.)

(Seal.)

STEWART BROS., PORT
CREDIT.

(Sgd.) WILLIAM STEWART,

(Sgd.) ROBERT STEWART.

HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

(Sgd.) W. W. POPE, *Secretary*.

(Sgd.) A. BECK, *Chairman*.

The following is a copy of the agreement for the supply and erection of the steel work.

THIS AGREEMENT made this 17th day of September, A.D. 1910.

BETWEEN :

THE JENKS DRESSER COMPANY LIMITED, OF SARNIA, ONTARIO,
hereinafter called the "Contractors,"

Parties of the First Part.

and

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, here-
inafter called the "Commission,"

Parties of the Second Part.

WITNESSETH, that in consideration of the covenants and agreements on the part of the Commission hereinafter contained, the Contractor hereby covenants and agrees with the Commission as follows:

1. In this contract the word "Work" or "Works" shall unless the contract conveys a different meaning, mean the whole of the Work or Works, and material, matters and things required to be done, furnished and performed by the Contractor under this contract. The word "Engineer" shall mean the Chief Engineer for the time being appointed by the Commission and having control over the Work or Works.

2. Wherever in this agreement the Contractor or Commission are mentioned or referred to, such mention or reference shall extend to, and be binding upon the heirs, executors, administrators, successors, or assigns of the said parties respectively.

3. The following documents:

(a) Commission's specifications for Steel Work, Port Credit Transformer Station, with attached Instructions to Bidders, and Form of Tender, including the following drawings, P.S.C.-100910911 pages marked "A."

2-S-13003—Port Credit Station Site—Dated August 5th, 1910.

4-S-13013—Plan of Foundations—Dated August 30th, 1910.

4-S-13015—Plan of Main Floor and Gallery—Dated August 29th, 1910.

4-S-13016—End Elevations—Dated August 30th, 1910.

4-S-13017—Front and Rear Elevations—Dated August 30th, 1910.

4-S-13018—Steel Diagrams—Dated August 30th, 1910.

4-S-13010—Wall Detail—Dated August 31st, 1910.

4-S-13020—Longitudinal Section—Dated August 31st, 1910.

4-S-13021—Roof Plan—Dated August 31st, 1910.

4-S-13022—Cross Sections—Dated August 31st, 1910.

(b) General Specifications for Material and Workmanship, etc. (26 pages) marked "E."

(c) General Conditions of Contract (11 pages) marked "C."

(d) Contractors' Bond (pages marked "B") shall be read into and form part of this contract.

Should any of the above documents contain contradictory clauses, preference shall be given to the documents in the order given above.

4. Contractors agree:

(a) To supply all necessary material, labor and plant, required for fabrication, delivery, and erection of steel work for Commission's Transformer Station near Port Credit, Province of Ontario, according to specifications and drawings attached hereto.

(b) To use the best material, and complete the said steel work in a thorough, substantial, and workmanlike manner, in strict accordance with specifications and drawings, and to the satisfaction of the Chief Engineer, upon the dates and times hereinafter mentioned for the sum of Four Thousand Six Hundred and Fifty Dollars (\$4,650.00).

(c) To have roof trusses and purlins permanently placed and riveted, on or before the 15th day of November, 1910.

(d) To have all other steel work, set out herein, fully completed on or before December 15th, 1910.

(e) Time shall be deemed to be the material and essence of this contract.

(f) Not to assign this contract without the written consent of the Commission.

(g) To deliver to the Commission a Bond satisfactory to the Commission to secure the sum of Eleven Hundred and Sixty Dollars (\$1,160.00) for the proper performance of this contract. It shall be provided in said Bond that without notice to the surety the said documents and this contract, or any part thereof, may from time to time be varied, and that the said surety shall not be released, or the liability under the Bond affected by any such variation.

5. The Commission agrees:

(a) The Engineer shall pursuant to paragraph 7 of General Conditions, give his order to the contractors to proceed with the Work or Works herewith immediately.

(b) To pay the Contractors for the said Work the sum of Four Thousand, Six Hundred and Fifty Dollars (\$4,650.00) on the dates and times set out in specifications.

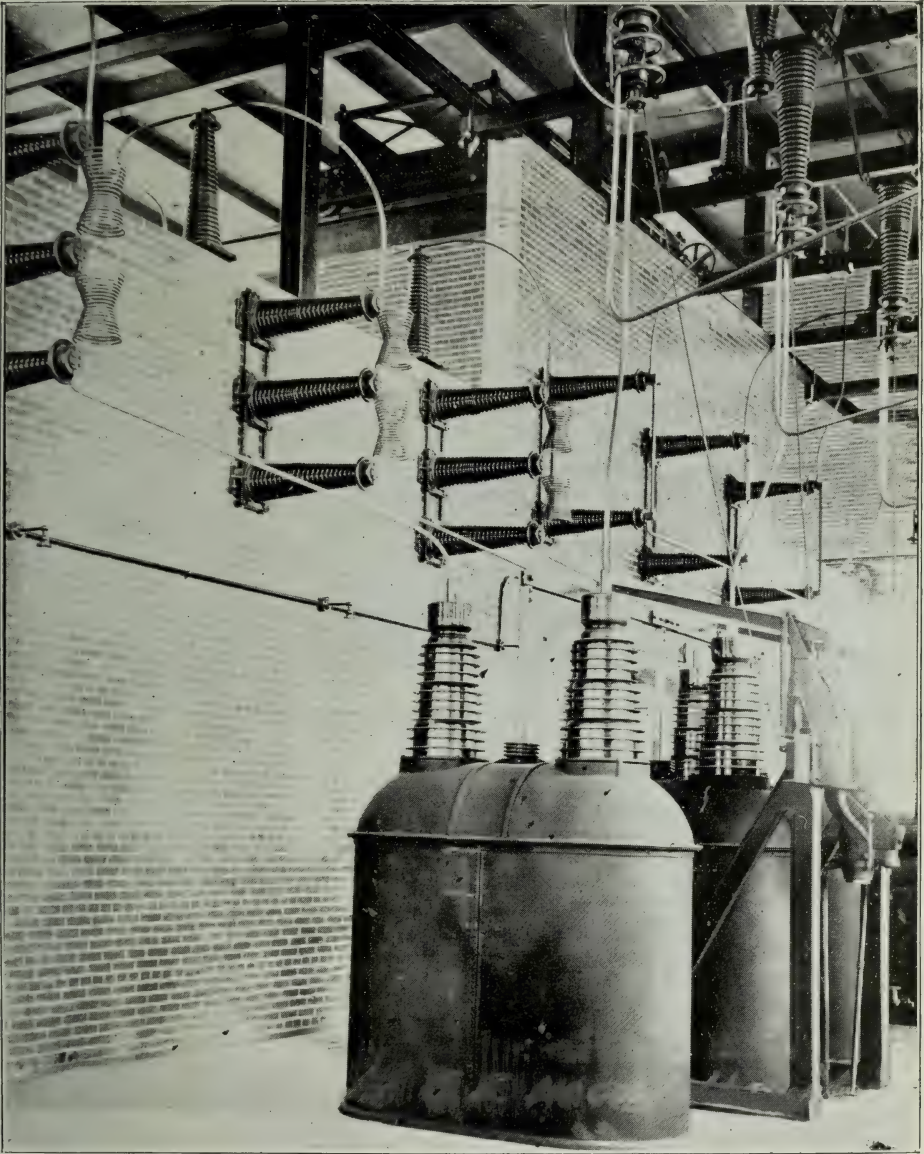
(c) To have bearing stones for the support of Roof Trusses permanently set on or before November 1st, 1910.

6. It is further mutually agreed:

(a) That Commission's Chief Engineer shall be the sole judge as to whether the said contract has been completed and the Work or Works done in accordance with specifications and drawings attached hereto, and no payment, certificate, or other act, matter or thing, done or omitted under this contract, shall bar or prejudice the rights of the Commission in this respect.

(b) If the contractors do not in the opinion of the engineer carry on the works with sufficient speed to complete the work on said dates, the Commission may at its option be released from this agreement and the contractors shall upon notice in writing, immediately discontinue the works, and if required by the said engineer, the contractors shall immediately remove the whole or any part of the said equipment, works, or material, to be specified by the engineer, that has been delivered to the Commission, and the Commission may at its option proceed with the said works. The Commission shall not be liable for any loss, costs or damages arising before or after the release of the Commission from this agreement.

(c) All the rights and remedies of the Commission and of the engineer, acting on their behalf, may be exercised and continued concurrently or in the alternative.

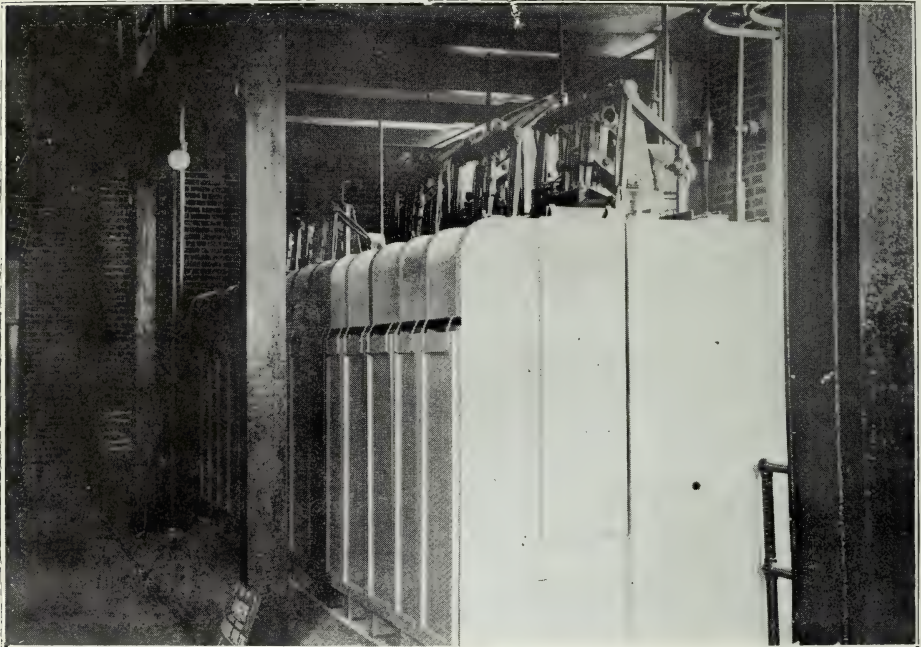


High Tension Switch, London Station.

(d) If within twelve months from date of the final certificate of the engineer, it appears that unsound or defective material has been used by the contractors, or the said works have not been executed in a substantial, proper, and workmanlike manner, the contractors shall be liable to the Commission for all damages arising

therefrom. No certificate, payment, or other act, matter or thing, done or omitted under this contract, shall bar or prejudice the rights of the Commission in this respect.

(e) In case the corporation of the Town of Brampton, or any other person, firm or corporation, which has or shall contract with the Commission for a supply of power, or any person or company which has or shall contract for the building, electrical or other appliances in any way connected with the plan of said transformer station, shall suffer damages by breach of this contract by the contractors, and such municipal corporation, firm, person or corporation would, if the contractors had made this contract directly with them have a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for, or on behalf of, such municipal corporation, person, firm or corporation, and not-



13,200 Volt Bus Structure, London Station

withstanding any acts, decision or rule of law to the contrary the Commission shall be entitled to all the rights and remedies of such municipal corporation, person, firm or corporation, including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation, person, firm or corporation, shall have agreed with the Commission to pay any costs that may be adjudged to be paid. The rights and remedies of any such municipal corporation, person, firm, or corporation shall not be hereby prejudiced.

7. Neither party shall be liable for damages for breach of contract, caused by strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war, or any other cause reasonably beyond its control, and should any delay in the performance of this contract be caused to any party thereby, the contractors shall not be bound

to deliver or the Commission shall not be bound to accept the work or works or material during such time, and the time for the performance of this contract by both parties shall be correspondingly extended.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption in so far as they are able, and when such interruption shall have ceased, the parties shall be prompt and diligent to perform the contract.

Provided that in construing this paragraph the doctrine of "ejusdem generis" shall not be applied.

8. (a) If any difference shall arise during the progress or after the completion of the works, as to any matter or thing arising under or out of this contract, such difference or differences, shall when the work is completed be referred to two arbitrators, one to be chosen by each of the parties hereto and they shall choose a third arbitrator, but if they cannot agree, such third arbitrator shall be chosen by the Chief Justice at the time of the King's Bench Division of the High Court of Justice. When possible the arbitrators shall decide such difference in a summary manner. Either party may appeal from any award of the arbitrators, as provided by the Arbitration Act, O.S. 1909, Chap. 35, but no such appeal shall be carried beyond the decision of the Court of Appeal of Ontario.

(b) The arbitrators shall not consider any matter or difference which is expressly or by implication required or permitted to be decided by the Engineer, or as to the grounds upon which in the opinion they have been formed, or discretion exercised by the engineer. If any such matter or difference shall arise and the Contractors claim that such matter or difference shall be determined by arbitrators, the contractors may apply in writing to the Commission, to waive this paragraph 8 (b) and permit the said matter or difference to be referred under paragraph 8 (a) to said arbitrators.

This agreement shall extend to and be binding upon and enure to the benefit of the heirs, executors, administrators, successors and assigns of the said parties respectively.

IN WITNESS WHEREOF the Commission and the Contractors have respectively affixed their Corporate Seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[Seal.]

[Seal.]

JENKS DRESSER COMPANY
LIMITED, of Sarnia.

(Sgd.) R. M. NORTON, Sec'y.

HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

(Sgd.) A. BECK, Chairman.

(Sgd.) W. W. POPE, Secretary.

Guelph Station.

A 13,200 volt oil switch with switchboard panel and meters and an electrolytic arrester were installed in our Guelph Transformer Station to supply energy to the Ontario Agricultural College. The wiring is arranged to provide for the transmission of energy over either of two lines running to the College. The electrical equipment was supplied and installed by the Canadian General Electric Company, and the concrete cell work was built by the Commission, since it was not considered advisable to have outside masons working in the station.

Woodstock Station.

The Corporation of Tillsonburg was not included in the original system, and since they entered into a contract at a later date, it was necessary to make provision for the additional energy supply in the Woodstock Station. An oil switch switchboard panel with meters and a lightning arrester were installed. The oil switch was supplied by the Canadian General Electric Company, and the balance of the equipment by the Canadian Westinghouse Company.

Waterdown District.

Energy is to be supplied to the Village of Waterdown and the vicinity by three 75 kv-a. transformers stepping down from 13,200 volts to 2,200 volts, which will be furnished under contract installed by the Canadian Crocker-Wheeler Company for \$1,950.00. The switching equipment will be supplied and installed by the Canadian General Electric Company at a cost of \$1,800.00, and consists of a 13,000 volt oil switch, a 13,000 volt shunted multigap arrester set with choke coils, and two feeder panels each with a recording meter. One feeder supplies the Village of Waterdown, the other supplies the Dominion Sewer Pipe Company near Waterdown.

Arrangements were made with the Dominion Sewer Pipe Company whereby our equipment might be installed in one of their buildings, thereby saving the expense of constructing a transformer station building.

The manufacture of the apparatus is now under way and it is expected the station will be in operation before the end of December.

This station is supplied with power by a single circuit line from the Dundas Sub-Station.

Port Stanley.

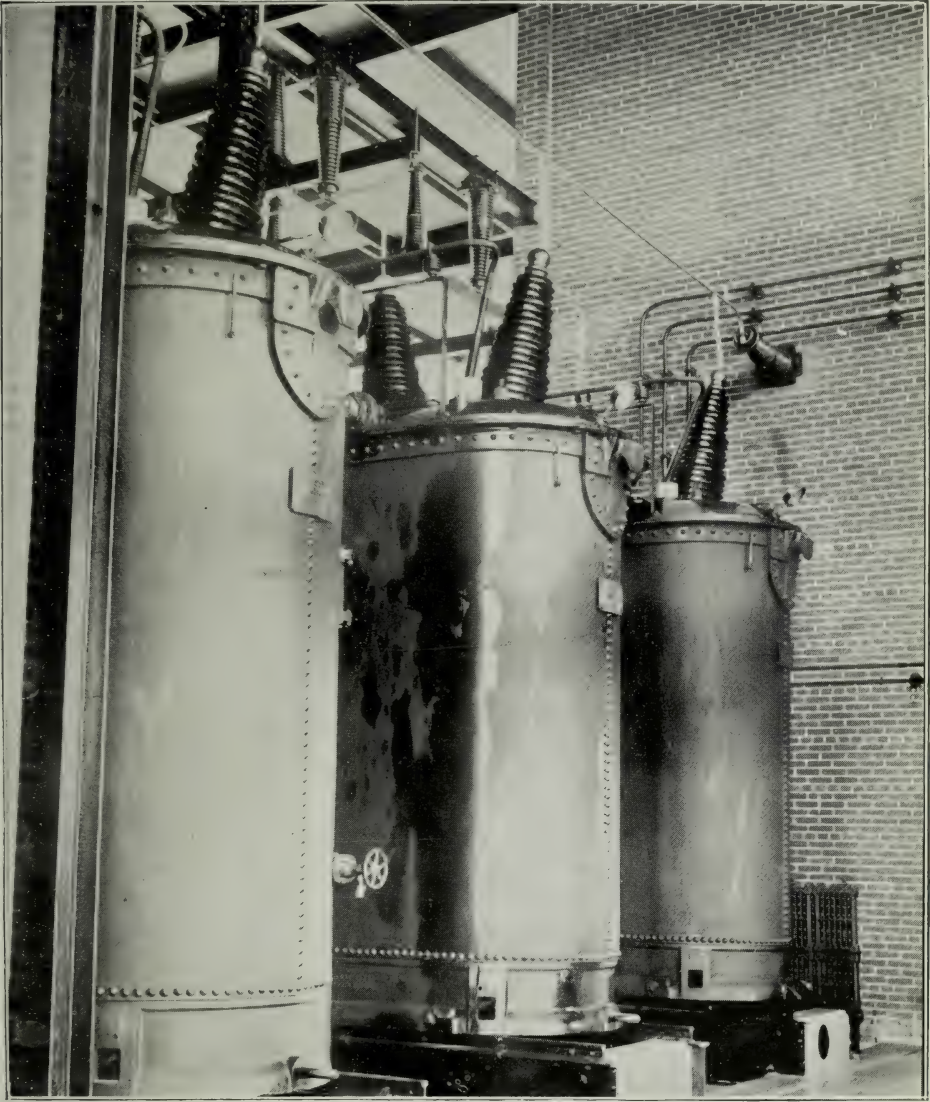
The equipment required for supplying this Corporation consists of three 50 kv-a., 13,200/2,300 transformers, a 13,200 volt oil switch, 13,200 volt lightning arrester, and a 2,200 volt feeder switch with recording wattmeter. The building to house apparatus will be provided by the Corporation. The Commission will purchase and install the equipment. Siemens Bros. Dynamo Works has the contract for the equipment. Energy will be supplied from St. Thomas transformer station.

Norwich.

This equipment is similar to that required for Port Stanley. The Corporation will provide and construct the building in accordance with drawings furnished by the Commission. The Siemens Company will supply the equipment. Energy to be supplied from Woodstock transformer station.

Beachville.

The same conditions exist here relative to the construction of the sub-station and the supply of the equipment as at Norwich. Woodstock transformer station will supply the energy.



Transformers, St. Thomas Station.

Since there are several villages at present considering taking energy from the System, it was considered advisable to purchase a complete station equipment for an extra station similar to those just mentioned, and accordingly a contract was made with the Siemens Dynamo Works for four complete equipments (Port Stanley, Norwich and Beachville, and one extra).

A copy of the agreement with Siemens Brothers Dynamo Works for the equipment for the above four stations is as follows:—

THIS AGREEMENT made this Fourth day of October, A.D. 1911.

BETWEEN :

SIEMENS BROTHERS DYNAMO WORKS, LIMITED, OF LONDON, ENGLAND, hereinafter called the "Contractors,"

Party of the First Part.

and

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter called the "Commission,"

Party of the Second Part.

WITNESSETH, that the parties covenant, promise and agree each with the other as follows:—

1. Wherever in this Indenture the Contractors or the Commission are referred to, such mention shall extend to and be binding upon the successors, or assigns of the said parties hereto respectively.

2. The following documents:—

(a) The Commission's specifications for electrical equipment for 150 kw. transformer station Port Stanley, Norwich, and Beachville, and 225 kw. transformer station Baden, No. P.N.B.B. 111006, marked "A."

(b) The Contractors' quotation No. 522, dated October 4th, marked "B."

(c) Blue print of Commission's drawings No. 3 E.M. 89, dated September 28th, 1911, marked "C," shall be read with and form part of this contract.

3. The Contractors agree:—

(a) To furnish all material and labor, to pay all freight charges, and deliver, install, test and place in satisfactory operating condition three (3) 50 kv-a., 25 cycle, single phase, transformers, including switching and protective apparatus, bus bars and wiring, as set out in the specifications and exhibits hereto attached, in the following stations, viz., in the Village of Port Stanley in the County of Elgin, in the Village of Norwich in the County of Oxford, and in the Police Village of Beachville in the County of Oxford; also three (3) 75 kv-a. transformers, 25 cycle, single phase, and all switching and protecting apparatus, bus bars and wiring, as set forth above, in the Station in the Police Village of Baden in the County of Waterloo, all as set forth in the said plans, specifications and exhibits attached hereto.

(b) To use the best material, and to construct, install, equip and test all of the above mentioned equipment in a thorough workmanlike manner and in strict conformity with the said plans, specifications and exhibits, and to the entire satisfaction of the Commission's Chief Engineer.

(c) To fully complete, install, test and deliver all apparatus covered by this contract in complete working order on or before the Twentieth day of March, A.D. 1912.

4. Time shall be considered to be material and of the essence of this contract.

5. The Commission agrees:—

To pay the Contractors for the said transformers, equipment and appliances when delivered, tested and installed upon the terms and conditions set forth in the said specifications, the sum of Twelve Thousand Five Hundred Dollars, (\$12,500.00).

6. It is further agreed:—

(a) If the Contractors do not in the opinion of the Chief Engineer of the Commission carry on the work of installing and equipping the said transformers as provided herein with sufficient speed to complete the work at the said date, the Commission may at its option be released from this agreement, and the Contractors shall upon notice in writing immediately discontinue the works, and if required by the said Engineer, the Contractor shall immediately remove the whole or any part of the said equipment to be specified by the Engineer that has been delivered to the Commission, and the Commission may at its option proceed with the said works. The Commission shall not be liable for any loss, costs or damages arising before or after the release of the Commission from this agreement.

(b) All the rights and remedies of the Commission and of the Engineer, acting on their behalf, may be exercised and continued concurrently or in the alternative.

(c) If within twelve months from the date of the final certificate of the Engineer, it appears that unsound or defective material has been used by the Contractors, or the said work has not been executed in a substantial, proper and workmanlike manner, the Contractors shall be liable to the Commission for all damages arising therefrom. No certificate, payment, or other act, matter or thing done or omitted under this contract, shall bar or prejudice the rights of the Commission in this respect.

(d) In case any municipal corporation, or any person, firm or corporation contracting with the Commission for a supply of power, or any person, firm or corporation which shall contract with such municipal corporation or with the Commission for a supply of power, shall suffer damages by breach of this Contract by the Contractors, and the said municipal corporations, person, firm or corporation would, if the Contractors had made this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of said Municipal Corporation, person, firm or Corporation, notwithstanding any acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such municipal corporation, person, firm or corporation, including the right to receive such damages, but no action shall be brought by the Commission until such municipal corporation, person, firm or corporation shall have agreed with the Commission to pay any costs that may be adjudged to be paid. The rights and remedies of any such municipal corporation, person, firm or corporation shall not be hereby prejudiced.

7. The contractors are not to assign or sublet this contract or any part thereof without the written consent of the Commission.

8. Notwithstanding anything contained herein to the contrary it is agreed that any inspection or approved certificates herein provided for in the work shall be understood as being only for the information of the Commission and shall not

be considered final, and shall not in any way relieve the contractors from the responsibility of completing this contract, and shall be subject to final inspection by the Engineer after the completion of the works.

9. For all purposes of this Indenture, notice shall be served upon the Engineer or his appointee for the Commission, and upon Arthur S. Herbert, Canadian Manager, or such other person as they may from time to time appoint as such, at their office in the City of Toronto, for the Contractors.

10. Neither party shall be liable for damages for breach of contract caused by strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war, or any other cause reasonably beyond its control, and should any delay in the performance of this contract be caused to either party thereby the Contractors shall not be bound to deliver, and the Commission shall not be bound to accept equipment during such time, and the time for performance of this contract by both parties shall be correspondingly extended.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption, in so far as they are able, and when such interruption shall have ceased the parties shall be prompt and diligent to perform the contract.

Provided that in constructing this paragraph the doctrine of "ejusdem generis" shall not be applied.

11. If the difference shall arise during the progress or after the completion of the works as to any matter or thing arising under or out of this contract, such difference shall be referred to three arbitrators, one to be appointed by each of the parties hereto, and the third to be appointed by such two arbitrators, or if they cannot agree, such third arbitrator shall be chosen by the Chief Justice at the time of the King's Bench Division of the High Court of Justice. When possible the arbitrators shall decide such difference in a summary manner. Either party may appeal from an award of the arbitrators as provided by the Arbitration Act O.S. 1909, but no such appeal shall be carried beyond the decision of the Court of Appeal for Ontario.

12. This agreement shall extend to and be binding upon, and enure to the benefit of the successors and assigns of the said parties respectively.

IN WITNESS WHEREOF the Contractors and the Commission have respectively affixed their Corporate Seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[Seal.]

[Seal.]

{ SIEMENS BROTHERS DYNAMO
WORKS, LIMITED, OF LONDON,
ENGLAND.

{ (Sgd.) ARTHUR HERBERT, *Can-
adian Manager.*

{ HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

{ (Sgd.) A. BECK, *Chairman.*

{ (Sgd.) W. W. POPE, *Secretary.*

PORT ARTHUR SYSTEM.

An agreement was signed with the Kaministiquia Light and Power Company on September 9th, 1909, as outlined in the Second Annual Report, after which drawings were prepared at the Toronto Office and tenders registered at Port Arthur on October 25th, 1909, for the excavation and construction of foundations for a substation before winter. The contract for this work was awarded to Seamen and Penniman of Port Arthur, since these contractors were thought to be the most capable of carrying out the work in the time specified at \$1,700.00.

The specifications for the electrical equipment were issued shortly after, and tenders called for on December 15th, 1909, and a contract awarded on February 15th, 1910, to the Siemens Bros. Dynamo Works for the entire equipment at \$15,500.00. This equipment is employed in supplying energy to the City of Port Arthur, and has a rated capacity of 2,250 kw. at 2,200 volts.

The following is a copy of Agreement for supply and erection of Electrical Equipment (first installation).

THIS INDENTURE made this 15th day of February, A.D. 1910.

BETWEEN:

SIEMENS BROTHERS DYNAMO WORKS LIMITED, OF LONDON, ENGLAND, hereinafter called the "Contractors."

Of the First Part.

and

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter called the "Commission."

Of the Second Part.

WITNESSETH, that in consideration of the covenants and agreements on the part of the Commission hereinafter contained, the Contractors hereby covenant and agree with the Commission as follows:

1. In this Contract the word "WORKS" shall, unless the context requires a different meaning, mean the whole Work or Works, material, matters and things required to be done, furnished and performed by the Contractors under this contract. The word "Engineer" shall mean the Chief Engineer for the time being appointed by the Commission and having control over the Work or Works.

2. Wherever in this Indenture the Contractors or Commission are mentioned or referred to, such mention or reference shall extend to and be binding upon the successors or assigns of the said Parties hereto respectively.

3. That the following documents:

(a) The Commission's General Conditions of Contract.

(b) The Commission's specifications for electrical equipment for Port Arthur step-down station together with the accompanying form of tender.

(c) The Commission's Drawings

4—S—P—003

2—S—P—004

(d) The Contractor's Drawings

C.N.111-7396

C.R.2865

C.N.111-734

S.C.N.5156-26406

C.R.3516

N.735

N.1171

G.11543

R.1741

N.1174

G.K.8639

N.12056

N.11494

(e) Contractors specifications and descriptions of equipment accompanying tender.

(f) Contractors drawings, as subsequently approved by Chief Engineer.

(g) Contractors Bonds:

One copy attached hereto. shall be read and form part of this contract.

4. The contractors covenant and agree to furnish, transport, and install free of all duty freight or other charges all the electrical apparatus and equipment required for the sub-station at Port Arthur in the Province of Ontario complete and ready for continuance service, the same to be completed and tested to the satisfaction of the engineer in strict accordance with the Commission's specifications for the sum not to exceed Fifteen Thousand Five Hundred Dollars (\$15,500.00).

5. For the purposes of addition and subtraction during the period of this contract, the unit prices for apparatus erected complete shall apply; those unit prices shall be approximately as filled in the blank spaces for the purposes in the form of Indenture hereby attached.

6. The contractors shall furnish to the Commission not later than March 15, 1910 working and assembling drawings of the equipment, showing lay-out in the station, and all features necessary to complete the building design, in accordance with the specifications, and they shall also supply full descriptions and operating characteristics of all apparatus. Further information as may be required from time to time shall also be furnished by the contractors upon request, a reasonable time being allowed for furnishing the same.

7. The contractors will at their own expense, including all freight, duty and charges, provide all and every kind of labor, machinery, plant and material, articles or things whatsoever necessary for the due completion and test ready for continuous service of all the work set out or referred to in the accepted tender and specifications and drawings hereto attached, as well as the plans for drawing to be hereafter furnished of the work, and will execute fully and completely the said work in all respects, test and deliver over the same complete, ready for continuous service to the Commission on the date hereinafter mentioned. The said works to be constructed of the best material of their several kinds and furnished in the best and most workmanlike manner in strict conformity with the specifications and drawings relating thereto to the entire satisfaction of the Engineer.

8. The contractors shall provide a curve drawing recording power factor meter, the same to be approved by the Engineer.

9. The switchboard panels to be of white carrarn marble with wax finish, or slate with dull black finish as specified.

10. Transformers shall be of the shell type and shall be provided with expansion tank, also with all other necessary and proper accessories and details as specified, and all properly connected for continuous service. Temperature measurements for the purpose of determining the characteristics of the transformer may be made by either or both the thermometer or resistance methods.

11. The contactors to execute and complete the work in all particulars and test and deliver the same over to the Commission on or before the Fifteenth day of August, 1910.

12. Time shall be deemed to be material and of the essence of this contract.

13. (a) If the contractors do not in the opinion of the said Engineer, carry on the works with sufficient speed to complete the work at said dates, the Com-



Switchboard, St. Thomas Station.

mission may, at its option, be released from this agreement, and the contractors shall upon notice in writing immediately discontinue the works, and if required by the said engineer the contractors shall immediately remove the whole or any part of the said equipment to be specified by the engineer that has been delivered to the Commission, and the Commission may at its option proceed with the said works. The Commission shall not be liable for any loss, costs, or damages arising before or after the release of the Commission from this agreement.

(b) All the rights and remedies of the Commission and of the engineer, acting on their behalf, may be exercised and continued concurrently or in the alternative.

(c) If within twelve months from the date of the final certificate of the engineer, it appears that unsound or defective material has been used by the contractor, or the said work has not been executed in a substantial, proper and

workmanlike manner, the contractor shall be liable to the Commission for all damages arising therefrom. No certificate payment, or other act, matter or thing done, or omitted under this contract, shall bar or prejudice the rights of the Commission in this respect.

(d) In case the corporation of the City of Port Arthur, which has contracted with the Commission for a supply of power, or any person, firm or corporation which shall contract with such municipal corporation or with the Commission for a supply of power shall suffer damages by breach of this contract by the contractors and said municipal corporation, firm or person would, if the contractors had made this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of said municipal corporation, person or firm, notwithstanding any acts, decision or rule of law to the contrary the Commission shall be entitled to all the rights and remedies of such municipal corporation, person or firm, including the right to receive such damages, but no action shall be brought by the Commission until such municipal corporation, person or firm, shall have agreed with the Commission to pay any costs that may be adjudged to be paid, the rights and remedies of any such municipal corporation, person or firm shall not be hereby prejudiced.

14. The contractors are not to assign or sub-let this contract or any part thereof without the written consent of the Commission.

15. The Commission agrees:

(a) That the engineer shall, pursuant to paragraph 7 of the Commission's General Conditions of contract attached hereto give his order to the contractors to proceed with the work at once and not later than the 4th day of March, 1910.

(b) To pay to the contractors or their legally appointed representative in Toronto for the said work, amount set out in paragraphs 4 and 5 of this contract, and in the specifications and tender attached thereto, which said payments will be made monthly upon engineer's certificates during the progress of installation as follows:

PAYMENT CLAUSE.

(a) Forty (40) per cent. of the contract amount upon the delivery in good order of the equipment at the station site, made in monthly payments equal to 85 per cent. of engineer's estimate of the value of the apparatus, and materials delivered, until the 40 per cent. has been paid.

(b) Additional thirty (30) per cent. of the contract amount upon the erection of the apparatus, made in monthly payments to equal 85 per cent. of engineer's estimate of work done, and apparatus erected, until the said 30 per cent. has been paid.

(c) Additional twenty (20) per cent. of the contract amount upon the completion of satisfactory tests, of apparatus at station, in monthly payments equal to 85 per cent. of engineer's certificates, until the said 20 per cent. has been paid.

(d) The balance of tender, or balance remaining unpaid at that time, ten (10) per cent. upon the final acceptance of the engineer.

16. Notwithstanding anything herein contained to the contrary it is agreed that any inspection or approved certificates herein provided for in the work shall

be understood as being only for the information of the Commission, and shall not be considered final, and shall not in any way relieve the contractors from the responsibility of completing this contract, and shall be subject to final inspection by the engineer after completion of the works.

17. For all purposes of this Indenture, notice shall be served upon the engineer, or his appointee, for the Commission, and upon Arthur S. Herbert, Canadian Manager, or such other person as they may from time to time appoint, as such, at their office in the City of Toronto, from the contractors.

18. The contractors to deliver to the Commission a bond satisfactory to the Commission to secure the sum of Three Thousand Eight Hundred and Seventy-



High Tension Entrance, Port Arthur Station.

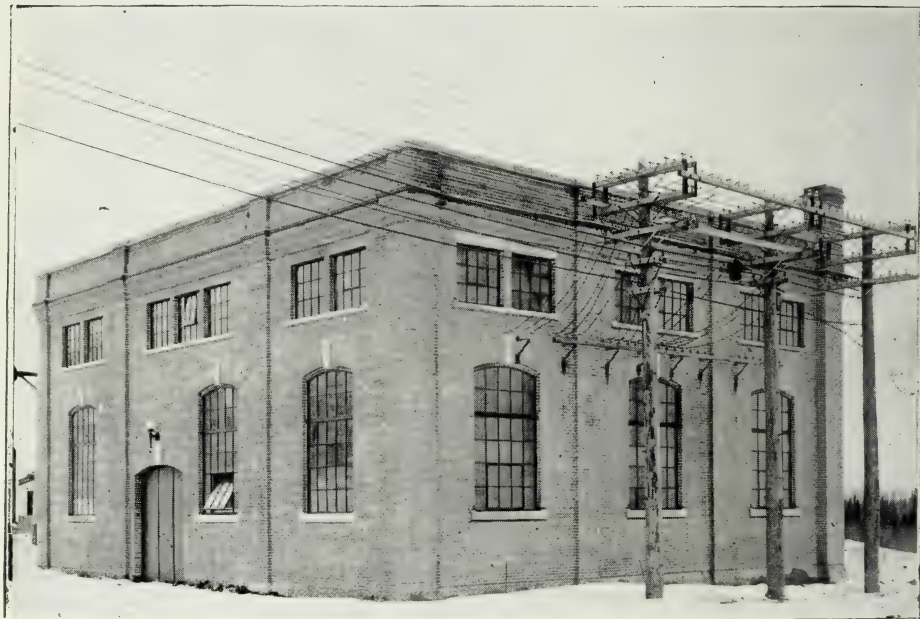
five Dollars(\$3,875.00) for the proper performance of this contract, and the work set out therein. It shall be provided in said bond that without notice to the surety the said documents and the contract or parts thereof may from time to time be varied, and the said sureties shall not be released or the liability under the bond in any way affected thereby.

19. Neither party shall be liable for damages for breach of contract caused by strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war, or any other cause reasonably beyond its control, and should any delay in the performance of this contract be caused to either party thereby, the Contractors shall not be bound to deliver and the Commission shall not be bound to accept equipment during such time, and the time for performance of this contract by both parties shall be correspondingly extended.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption, in so far as they are able, and when such interruption shall have ceased the parties shall be prompt and diligent to perform the contract.

Providing that in construing this paragraph the doctrine of "ejusdem generis" shall not be applied.

20. (a) If any difference shall arise during the progress or after the completion of the Works, as to any matter or thing arising under or out of this contract, such difference shall be referred to three Arbitrators, one to be appointed by each of the parties hereto, and the third to be appointed by such two Arbitrators, or if they cannot agree, such third arbitrator shall be chosen by the Chief Justice



Low Tension Outlets, Port Arthur Station.

at the time of the King's Bench Division of the High Court of Justice. When possible, the arbitrators shall decide such difference in a summary manner. Either party may appeal from an award of the arbitrators as provided by the Arbitration Act R.S.O. Chapter 62, but no such appeal shall be carried beyond the decision of the Court of Appeal for Ontario.

(b) The Arbitrators shall not consider any matter or difference which is expressly or by implication required or permitted to be decided by the Engineer, or as to grounds upon which or mode in which any opinion may have been formed or discretion exercised by the Engineer. If any such matter or difference shall arise and the Contractors claim that such matter or difference should be determined by arbitrators, the Contractors may apply in writing to the Commission, to waive this paragraph 20 (b); thereupon the Commission shall appoint a time and place to hear any representations of the Engineer or Contractors, and the Commission

may, in its sole discretion waive the provisions of this paragraph 20 (b) and permit the said matter or difference to be referred under paragraph 20 (a) to said Arbitrators.

21. This agreement shall extend to and be binding upon, and enure to the benefit of the successors and assigns of the said parties respectively.

IN WITNESS WHEREOF the Contractors and the Commission have respectively affixed their Corporate Seals, and the hands of their respective officers.

SIGNED, SEALED AND
DELIVERED.

WITNESS to the signature of
Siemens Brothers Dynamo Works,
"W. W. Macauley Pope."

[SEAL.]

[SEAL.]

SIEMENS BROTHERS DYNAMO
WORKS, LIMITED, OF LONDON,
ENGLAND

"Siemens Brothers Dynamo Works,
Ltd."

per M. B. Logan."

HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

(Sgd.) A. BECK, *Chairman*.

(Sgd.) W. W. POPE, *Secretary*.

Later, the City of Port Arthur required additional feeder equipment, and on October 14th, 1910, a second requisition was placed on the Siemens Company for switching and recording equipment to the value of \$4,040.

Arrangements were also made by which the city was allowed to place considerable of the street railway equipment in our station, since the space was available for such installation, and the operating costs were reduced considerably by this arrangement.

During the Winter Season of 1910 and 1911, the demand on this station was considerably greater than had been anticipated and the question of providing reserve transformer capacity was discussed with the municipal authorities. The proposition appealed to them especially, since they wished to have reserve energy available to supply new industries which might decide to locate at Port Arthur. Accordingly an additional contract was made with Siemens Bros. to the amount of \$11,200, which called for the delivery of three 750 kv.-a. transformers and the necessary switching equipment. The equipment is at present being installed, and will be ready for operation before the Winter Load occurs.

Tenders were requested for the construction of the building superstructure during May, 1910, and on June 22nd the contract was awarded to A. L. McRae of Port Arthur at \$15,150. This work was carried out by him during 1910 as well as that required in connection with some minor contracts and additional work as follows:—

Sept. 16.—\$1,350 to build high tension bus and switch structures.

Oct. 15.—An order for sprinkling tank on the basis of cost plus 15 per cent.

A copy of this agreement with Mr. McRae is as follows:—

THIS INDENTURE made this 28th day of July, A.D. 1910.

BETWEEN :

J. L. McRAE, of the TOWN of PORT ARTHUR, in the PROVINCE of ONTARIO, hereinafter called the “Contractor”

of the First Part

— and —

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, hereinafter called the “Commission”

of the Second Part.

WITNESSETH, that in consideration of the covenants and agreements on the part of the Commission hereinafter contained, the Contractor hereby covenants and agrees with the Commission as follows:—

1. In this contract the word “Work” or “Works” shall, unless the context requires a different meaning, mean the whole of the Work or Works, and material, matters and things required to be done, furnished and performed by the Contractor under this Contract. The word “Engineer” shall mean the Chief Engineer for the time being appointed by the Commission and having control over the Work or Works.

2. Wherever in this Indenture the Contractor or Commission are mentioned or referred to, such mention or reference shall extend to, and be binding upon the heirs, executors, administrators, successors, or assigns of the said parties respectively.

3. That the following documents:—

(a) Commission’s Instructions to Bidders for the Construction of Transformer Station Building, Port Arthur, dated 4th May, 1910 Two pages.

(b) Form of Tender (revised) dated June 7th, 1910. Six pages.

(c) Commission’s Specifications for Step-down Transformer Station Building, Port Arthur, P.A. 100428, containing 19 pages with index, together with the following drawings:

4-S-P001	Dated April 25th, 1910.
4-S-P005	“ “ 24th “
4-S-P007	“ “ 27th “
4-S-P008	“ “ 28th “
4-S-P009	“ “ 29th “
4-S-P010	“ “ 27th “
4-S-P011	“ “ 30th “
4-S-P012	“ “ 30th “
4-S-P013	“ “ 29th “

(d) General Conditions of Contract B. 90601.

(e) General specifications for material and class description of work entering into the construction of Station Buildings B. 90602.

(f) Contractor’s bond.

shall be read with and form part of this contract.

4. The Contractor covenants and agrees:—

(a) To supply all material, labor, tools, machinery and other plant, and

complete in every respect in strict accordance with the specifications and drawings, or as they may be amended from time to time, the step-down transformer station building superstructure at Port Arthur, Ontario.

(b) To use the best material and complete the said work in a thorough, substantial, workmanlike manner in strict conformity with the drawings, exhibits and specifications, except as amended in paragraph 6, Clause A and B, to the entire satisfaction of the Commission's Chief Engineer, for the sum of Fifteen Thousand One Hundred and Fifty Dollars (\$15,150).

(c) To fully complete the said works on or before the Fifteenth (15th) day of September, A.D. 1910.

(d) Time shall be deemed to be the material and essence of this contract.

(e) For all purposes of this Indenture, notice shall be served upon the Engineer, or his appointee for the Commission, and by the mailing of a letter postage prepaid, addressed to the Contractor, Port Arthur, Ontario, for the Contractor.



22,000 Volt Transmission Line, Port Arthur, Ont.

(f) To deliver to the Commission a Bond satisfactory to the Commission to secure the sum approximately, Three Thousand Seven Hundred and Eighty Dollars (\$3,780) for the proper performance of this contract. It shall be provided in said Bond that without Notice to the surety the said documents and this contract or any part or parts thereof may from time to time be varied, and that the said surety shall not be released, or the liability under the bond affected by any such variations.

(g) Not to assign or sublet this contract without the written consent of the Commission.

(h) That the unit prices stated in the Tender shall be used to adjust the contract prices in case of addition to, or deduction from, the amounts as indicated in the drawings or called for in the specifications.

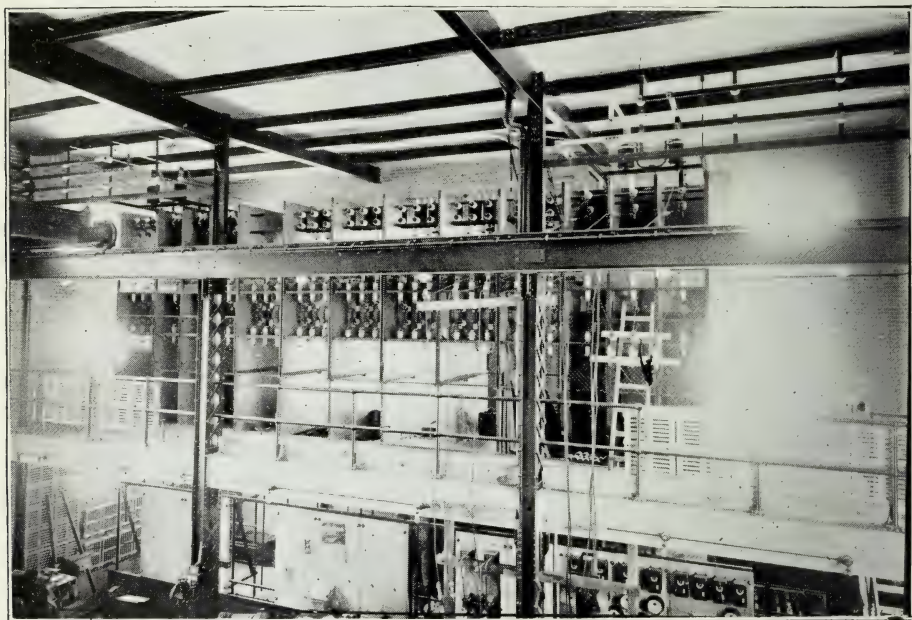
5. The Commission agrees:—

(a) That the Engineer shall, pursuant to Paragraph 7 of the General Conditions of Contract, give his order to the Contractor to proceed with the Work or Works at once.

(b) To pay to the Contractor for the said Works upon the terms and conditions set out in the specifications, and upon the terms particularly mentioned in Paragraph 4, Clauses A, B, and C.

6. Contractor agrees:—

(a) That the Engineer may (as provided in Section 9 General Conditions of Contract) within one month order the contract to be reduced by omitting the ceiling suspended from roof, and the tar and gravel roofing. In the event of such reduction the contract price shall be reduced by an amount determined by the unit prices contained in the tender.



Low Tension Busses, Port Arthur Station.

(b) It is mutually agreed, that the first grade local sand lime brick will be used in place of pressed brick as specified. With this exception the specifications for brick work shall apply.

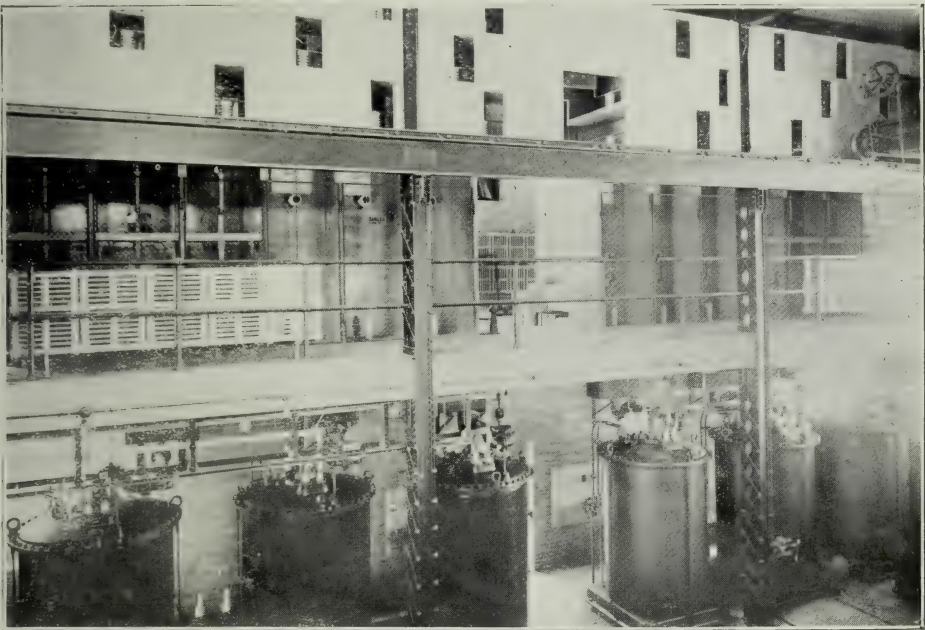
(c) That the Commission's Chief Engineer shall be sole judge as to whether the said contract has been completed and the Work or Works done in every respect in accordance with the specifications and drawings attached hereto, and no payment certificate or other Act, matter or thing done or omitted under this contract shall bar or prejudice the rights of the Commission in this respect.

(d) If the Contractor does not, in the opinion of the said Engineer, carry on the Works with sufficient speed to complete the work on said dates, the Commission may at its option be releaser from this agreement, and the Contractor shall upon notice in writing, immediately discontinue the Works, and if required by the said Engineer, the Contractor shall immediately remove the whole or any part of the

said equipment, works or material, to be specified by the Engineer, that has been delivered to the Commission, and the Commission may at its option proceed with the said Works. The Commission shall not be liable for any loss, costs or damages arising before or after the release of the Commission from this agreement.

(e) All the rights and remedies of the Commission and of the Engineer, acting on their behalf, may be exercised and continued concurrently or in the alternative.

(f) If within twelve months from the date of the final certificate of the Engineer, it appears that unsound or defective material has been used by the Contractor, or the said works have not been executed in a substantial, proper, and workmanlike manner, the Contractor shall be liable to the Commission for all damages arising therefrom. No certificate, payment, or other act, matter or thing



High Tension Busses and Transformers, Port Arthur Station.

done or omitted under this contract shall bar or prejudice the rights of the Commission in this respect.

(g) In case any Municipal Corporation which shall contract with the Commission for a supply of power, or any such Municipal Corporation, or with the Commission for a supply of power, shall suffer damage by breach of this contract by the Contractor, and such municipal corporation, firm, person or corporation would, if the Contractor had made this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings, or bring such action for, or on behalf of, such municipal corporation, person, firm or corporation, and notwithstanding any acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such municipal corporation, person, firm or corporation, including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation,

person, firm or corporation, shall have agreed with the Commission to pay any costs that may be adjudged to be paid. The rights and remedies of any such municipal corporation, person, firm or corporation shall not be hereby prejudiced.

7. Neither party shall be liable for damages for breach of contract caused by strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war, or any other cause reasonably beyond its control and should any delay in the performance of this contract be caused to either party thereby the Contractor shall not be bound to deliver or the Commission shall not be bound to accept the Work or Works or material during such time, and the time for performance of this contract by both parties shall be correspondingly extended.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption in so far as they are able, and when such interruption shall have ceased, the parties shall be prompt and diligent to perform the contract.

Provided that in construing this paragraph the doctrine of "ejusdem generis" shall not be applied.

8. (a) If any difference shall arise during the progress or after the completion of the Works, as to any matter or thing arising under or out of this contract, such difference or differences shall when the work is completed, be referred to two arbitrators, one to be chosen by each of the parties hereto, and they shall choose a third arbitrator, but if they cannot agree, such third arbitrator shall be chosen by the Chief Justice at the time of the King's Bench Division of the High Court of Justice. When possible, the arbitrators shall decide such difference in a summary manner. Either party may appeal from any award of the arbitrators, as provided by the Arbitration Act, O.S. 1909, Chap. 35, but no such appeal shall be carried beyond the decision of the Court of Appeal of Ontario.

(b) The arbitrators shall not consider any matter or difference which is expressly or by implication required or permitted to be decided by the Engineer, or as to the grounds upon which, or mode in which, any opinion may have been formed, or discretion exercised by the Engineer. If any such matter or difference shall arise, and the Contractors claim that such matter or difference should be determined by arbitrators, the Contractors may apply in writing to the Commission to waive this paragraph 8 (b) and permit the said matter or difference to be referred under paragraph 8 (a) to said arbitrators.

9. This agreement shall extend to, and be binding upon, and enure to the benefit of the heirs, executors, administrators, successors, and assigns of the said parties respectively.

IN WITNESS WHEREOF the Commission and the Contractors have respectively affixed their Corporate Seals and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

(Sgd.) JOHN L. McRAE.

{ HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

{ (Sgd.) A. BECK, *Chairman*.

{ (Sgd.) W. W. POPE, *Secretary*.

Mechanical Equipment.

Tenders for the boiler were called for on July 18th, 1910, and an order was issued on the Taylor-Forbes Company for the boiler erected and covered at \$367.

On September 19th, tenders were requested for radiators and on the 20th an order was placed with the same firm for radiators to the extent of \$498.61.

On September 27th tenders were called for installation of the heating system, and awarded to A. C. Waltz Company of Port Arthur for \$533.00. The tenders for the lighting system were called for on October 5th, and the contract was also awarded to the same firm for \$366.00, who submitted the lowest tender.

In addition to being awarded these contracts, this same contractor was instructed on November 5th to install the oil, water and air systems on the basis of cost plus 15 per cent., involving about \$200.00.

The valves for heating and other systems were supplied by the Canadian Fairbanks Company under previous contract.

Tenders were requested for an oil storage tank, and on July 19th the contract was awarded to Goldie and McCulloch of Galt, at \$157.00.

In October tenders were submitted for a water pump. An order was placed with the Gould Pump Company on November 9th for motor-driven pump at a cost of \$147.00.

In awarding the above contracts, the lowest tenderer received the order in each case, if upon investigation he was found competent to undertake the work and construct it in accordance with the specifications.

After considerable investigation an order was placed with the Geo. Anderson Company of Scotland, for a hand power crane of 15 tons capacity at \$1,152. This firm failed to make delivery within the specified time and after the expiration of a liberal extension of time, since the crane had not been shipped, the order was cancelled and placed with the Advance Machine Company at \$1,190 for delivery in seven weeks.

All this equipment has been installed during the period of this report.

Description of Installation.

The 22,000 volt three-phase lines pass through choke coils, disconnecting switches, and automatic oil switches to busses. The transformer banks are connected to the busses through automatic oil switches. Combination horn gap and oil damped resistance lightning arresters protect the incoming lines, and are connected just inside the entrance bushings.

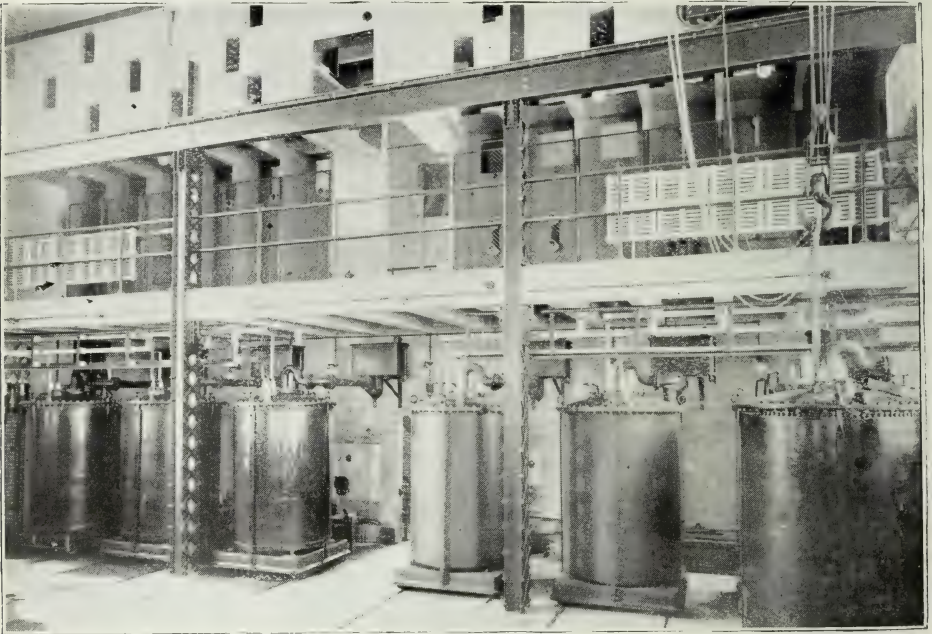
Each transformer bank consists of three 750 kv-a. oil-insulated water-cooled units connected in star on the high tension side and in delta on the low tension side. A spare 750 kv-a. transformer is provided to replace any which might become disabled.

The transformers and high tension equipment are located along one side of the building and gallery, over these is the 22,000 volt switch and bus. The low tension switches, busses and switchboards are similarly located on the opposite side of the building, while a main aisle the full height of the building over which a travelling crane runs, is provided for erection purposes as well as for any rotating machinery which the Corporation of Port Arthur may require.

Since the building was completed the Street Railway Department of the City has installed a 750 kv-a. motor generator set, converting the power from 2,200 volts three-phase, 60 cycle, to 600 volts direct current. The 2,200 volt leads on leaving the transformers pass across the main aisle in conduit to the low tension

equipment where they divide into two parts, each passing through an oil switch to a bus. According to the agreement between the Corporation and the Commission, the latter's equipment ended at the bus, but at the request of the Corporation several feeders were added, and may be connected by means of a three-pole double throw switch to either set of busses.

The type of construction employed for the building is similar to that of the other buildings in the Niagara System and the general specifications which were prepared for the former were utilized for the latter. The arrangement of this piping system is, in general, similar except that no air piping or oil filter have as yet been installed. The municipal water service was available for use, and only one water circulating pump was installed. It was later discovered, however, that the elevation of the station rendered the city water supply unreliable, and as a



High Tension Busses and Transformers, Port Arthur Station.

result, an open concrete sprinkling tank of a design similar to that employed at Niagara Falls was installed.

The operating board is located under the low tension gallery and opposite the transformers, and carries the low tension switches and all recording and indicating apparatus. The high tension switch controllers are placed on separate panels near the transformers. All switches are hand operated.

Transmission Line.

Specifications for this line were being prepared when the agreement with the Kaministiquia Light and Power Company was signed in September 9th, 1909.

On December 20th, 1909, specifications were issued and tenders called for by January 31st, 1910. Eighteen Contractors were notified, and three tenders received by the latter date. It was found advisable to furnish considerable material direct from the supply houses and the contract was awarded to the Hinners-Jones Electric Company of Fort William for \$8,997.10.

The line consists of two three-phase circuits of aluminum cable on separate poles, is about two miles in length and operates at 22,000 volts, 60 cycles.

The following is a copy of the agreement with the HINNERS-JONES Electric Company:—

THIS INDENTURE made this Fourth day of April, A.D. 1910.

BETWEEN :

HINNERS AND JONES ELECTRIC COMPANY of FORT WILLIAM,
ONTARIO, hereinafter called the “Contractors”

of the First Part

and

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, here-
inafter called the “Commission”

of the Second Part.

WITNESSETH, that in consideration of the Covenants and Agreements on the part of the Commission hereinafter contained, the Contractors hereby covenant and agree with the Commission as follows:—

1. In this contract the word “Work” or “Works” shall, unless the context requires a different meaning, mean the whole Work or Works, and material, matters and things required to be done, furnished and performed by the Contractors under this contract; the word “Engineer” shall mean the Chief Engineer for the time being appointed by the Commission, and having control over the Work or Works.

2. Wherever in this Indenture the Contractors or Commission are mentioned or referred to, such mention or reference shall extend to and be binding upon the executors, administrators, successors, or assigns of the said Parties respectively.

3. That the following documents:—

(a) The Commission’s General Conditions of Contract.

(b) The Commission’s Specifications for 25,000 volt transmission line for Port Arthur, with revised Form of Tender attached thereto.

(c) Drawings:

3-T-159, revised to December 16th, 1909.

4-T-190.

1-T-61.

1-T-62.

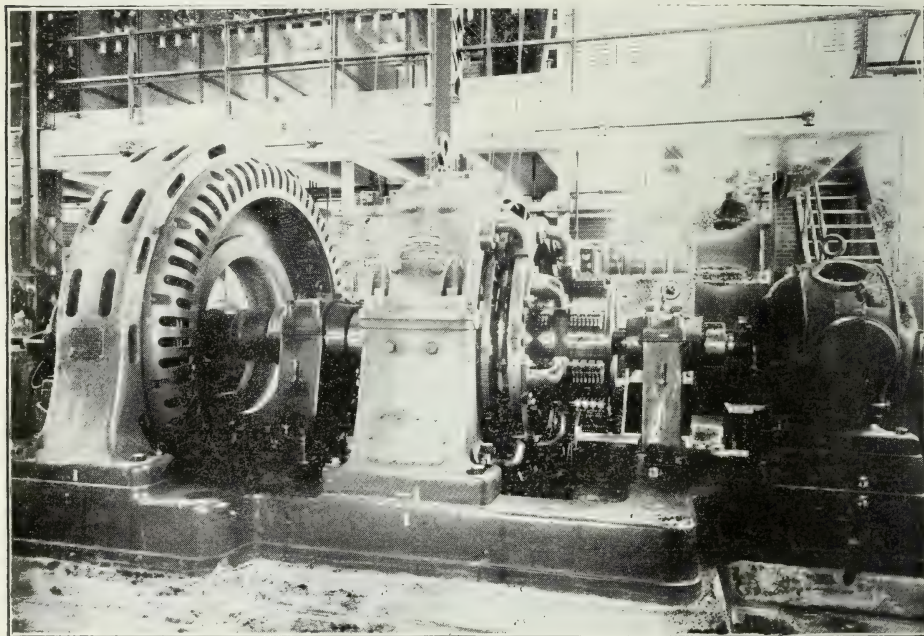
1-T-64.

(d) Contractors’ Bond:

shall be read into and form part of this Contract.

4. The Contractors covenant and agree to furnish all necessary materials (excepting materials supplied by the Commission as hereinafter provided), labor, tools, machinery and other plant, and to build, erect and complete, in a satisfactory and workmanlike manner, all Work or Works required in connection with the installation of two 25,000 volt, single current wood pole transmission lines, and one telephone circuit at or near Port Arthur, in the Province of Ontario, each approximately four miles long, all according to agreements, specifications and drawings, exhibited to the Contractors and attached hereto, for the sum of Eight Thousand Nine Hundred and Ninety Seven Dollars and Twenty Cents (\$8,997.20).

5. All poles shall be according to specifications, with 8 in. tops, and a maximum sweep of one inch in every five feet measurements, to be made as specified.
6. All poles shall be provided with peak castings for the second ground wire.
7. The Commission will supply the following materials f.o.b. Port Arthur:—
 - (a) Aluminum Cables and Tie Wires.
 - (b) Telephone Wire and Tie Wires.
 - (c) Ground Cables with Tie Wires.
 - (d) 25,000 Volt Porcelain Insulators.
8. The Commission will also provide the right-of-way for the said line.
9. For the purpose of addition and subtraction from the Work, the unit price set forth in the revised Form of Tender shall apply, it being understood that the specified distance of four miles is approximate only.



Motor Generator Set, Port Arthur Station.

10. The Contractors will at their own expense provide all and every kind of labor, machinery, plant and material, articles or things whatsoever, except as hereinbefore set out and necessary for the due completion and test ready for continuous service of all the Work or Works set out or referred to in the accepted Tenders, and specifications and drawings, hereto attached, and will execute fully and completely the said Work in all respects, test and deliver over the same, complete ready for continuous service to the Commission, on the date hereinafter mentioned. The said Works to be constructed of the best material of their several kinds and finished in the best and most workmanlike manner, in strict conformity with the specifications and drawings relating thereto, to the entire satisfaction of the Engineer.

11. The Contractors to execute and complete the Work in all particulars, and test and deliver the same over to the Commission, on or before the 1st day of June, A.D. 1910.

12. Time shall be deemed to be material, and of the essence of this Contract.

13. For all purposes of this Indenture, notice shall be served upon the Engineer, or his appointee for the Commission and upon the Contractors at their office in Fort William, Ontario, for the Contractors.

14. The Contractors to deliver to the Commission a bond satisfactory to the Commission to secure the sum of Two Thousand Three Hundred Dollars (\$2,300.00) for the proper performance of this contract and the work set out therein. It shall be provided in said bond that without notice to the surety the said documents and the contract or parts thereof may from time to time be varied and the sureties shall not be released or the liability under the bond in any way affected thereby.

15. The Contractors are not to assign this contract or any part thereof without the written consent of the Commission.

16. The Commission agrees:—

(a) That the Engineer shall, pursuant to paragraph 7 of the Commission's General Conditions of contract attached hereto, give his order to the Contractors to proceed with the work at once, and not later than the 15th day of April, 1910.

(b) To pay the Contractors or their legally appointed representatives in Fort William for the said work, the amount set out in paragraph 4 of this Contract, and in the specifications and Tender attached hereto, which said payment will be made monthly upon Engineer's certificates, during progress as follows:—

The Engineer shall make at the end of each month a progress estimate of all work done, and material delivered, and within twenty-five days thereafter, eighty-five (85) per cent., less previous payments of the money due as based upon this estimate shall be paid the contractor in cash.

17. Notwithstanding anything herein contained to the contrary, it is agreed that any inspection or approved certificates herein provided for in the work shall be understood as being only for the information of the Commission, and shall not be considered final, and shall not in any way relieve the Contractors from responsibility of completing this contract, and shall be subject to final inspection by the Engineer after completion of the works.

18. It is further agreed:—

(a) If the Contractors do not in the opinion of the said Engineer, carry on the works with sufficient speed to complete the work at said dates, the Commission may, at its option, be released from this agreement, and the Contractors shall upon notice in writing immediately discontinue the works, and if required by the said Engineer the Contractors shall immediately remove the whole or any part of the said equipment to be specified by the Engineer that has been delivered to the Commission, and the committee may at its option proceed with the said works. The Commission shall not be liable for any loss, costs or damages arising before or after the release of the Commission from this agreement.

(b) All the rights and remedies of the Commission and of the Engineer, acting on their behalf, may be exercised and continued concurrently or in the alternative.

(c) If within twelve months from the date of the final Certificate of the Engineer, it appears that unsound or defective material has been used or delivered by the Contractor, or the said works have not been executed in a substantial, proper and workmanlike manner, the Contractor shall be liable to the Commission for

all damages arising therefrom. No certificate payment, or other act, matter or thing done or omitted under this contract shall bar or prejudice the rights of the Commission in this respect.

(d) In case the Municipal Corporation of the City of Port Arthur has contracted with the Commission for a supply of power, or any person, firm or corporation which shall contract with such Municipal Corporation, or with the Commission for a supply of power, shall suffer damages by breach of this contract by the Contractors, and such municipal corporation, firm, person or corporation would, if the Contractors had made this contract directly with them, have had a right to recover such damages or commence any proceedings or any other remedy, the Commission shall be entitled to commence any such proceedings or bring such action for or on behalf of such municipal corporation, person, firm or corporation,



2,200 Volt Pole Line, Penetang Station.

and notwithstanding any acts, decision or rule of law to the contrary, the Commission shall be entitled to all the rights and remedies of such municipal corporation, person, firm or corporation, including the right to recover such damages, but no action shall be brought by the Commission until such municipal corporation, person or firm, or corporation shall have agreed with the Commission to pay any costs that may be adjudged to be paid. The rights and remedies of any such municipal corporation, person, firm or corporation shall not be hereby prejudiced.

19. Neither party shall be liable for damage for breach of contract caused by strikes, lock-outs, accidents, riots, fires, explosions, acts of God, war or any other cause reasonably beyond its control and should any delay in the performance of this contract be caused to either party thereby, the Contractors shall not be bound to deliver or the Commission shall not be bound to accept equipment during such time, and the time for performance of this contract by both parties shall be correspondingly extended.

Provided further that the parties shall be prompt and diligent to remove the cause or causes of interruption in so far as they are able, and when such interruption shall have ceased the parties shall be prompt and diligent to perform the contract.

Provided that in construing this paragraph the doctrine of "ejusdem generis" shall not be applied.

20 (a) If any difference shall arise during the progress or after the completion of the Works as to any matter or thing arising under or out of this contract, such differences shall be referred to three arbitrators; one to be appointed by each of the parties hereto, and the third to be appointed by such two arbitrators, or if they cannot agree such third arbitrator shall be chosen by the Chief Justice at the time of the King's Bench Division of the High Court of Justice. When possible, the arbitrators shall decide such difference in a summary manner. Either party may appeal from any award of the arbitrators as provided by the Arbitration Act R.S.O.C. Chap. 62, but no such appeal shall be carried beyond the decision of the Court of Appeal for Ontario.

(b) The arbitrators shall not consider any matter or difference which is expressly or by implication required or permitted to be decided by the Engineer, or as to grounds upon which, or mode in which, any option may have been formed, or discretion exercised by the Engineer. If any such matter or difference shall arise and the Contractors claim that such matter or difference should be determined by arbitrators, the Contractors may apply in writing to the Commission, to waive this paragraph 20 (b); thereupon the Commission shall appoint a time and place to hear any representations of the Engineer or Contractors, and the Commission may, at its sole discretion, waive the provisions of this paragraph 20 (b) and permit the said matter or difference to be referred under paragraph 20 (a) to said arbitrators.

21. This agreement shall extend to and be binding upon and enure to the benefit of the successors and assigns of the said parties respectively.

IN WITNESS WHEREOF the Contractors and the Commission have respectively affixed their Corporate Seals, and the hands of their proper officers.

SIGNED, SEALED AND
DELIVERED

in the presence of

[SEAL.]

[SEAL.]

HINNERS AND JONES ELECTRIC
COMPANY OF FORT WILLIAM,
ONTARIO.

(Sgd.) F. S. JONES.

HYDRO-ELECTRIC POWER
COMMISSION OF ONTARIO.

(Sgd.) A BECK, *Chairman*,
(Sgd.) W. W. POPE, *Secretary*.

The construction of the transmission lines was started early in the spring of 1910, but several changes were made by the City of Port Arthur which required an increase in the length of a number of poles, and resulted in considerable revision of the right-of-way.

Considerable quicksand and muskeg were encountered, and necessitated a large amount of special work so that lines were not completed until the spring of 1911, although the first of the two lines was ready for operation at the close of the season of 1910.

The lines were erected along independent streets for considerable distance in Port Arthur, while for about one-half mile, they were built parallel, 14 ft. apart, along an old railway right-of-way. The remainder of the line was built along each side of highway.

The majority of the poles were Western Cedar, the arms treated short-leaf yellow pine and the pins treated locust. The entire line was tested out at a potential of 25 per cent. over normal operating conditions, and in this as well as other particulars proved satisfactory.

SIMCOE SYSTEM.

A contract was entered into between the Simcoe Railway and Power Company, and the Commission (which is elsewhere described) to provide for a supply of electrical energy to Midland and Penetanguishene.

The energy supplied Midland is obtained from the Power Company at 2,200 volts, three-phase, 60 cycles at their substation in Midland, metered and delivered directly to the Corporation.

The Town of Penetanguishene is supplied with energy from the Power Company at 22,000 volts, three-phase, 60 cycles, at a point on their line near their Midland substation. The Commission constructed a single circuit wooden pole line from this point to Pentanguishene, a distance of 4.5 miles. The line was erected to follow the streets of Midland, and they run across country to Penetanguishene. It consists of No. 2 B & S aluminum cable supported by thirty-five 40 ft. poles, with a ground wire strung along the pole peaks. Telephone wires were also run the entire length of the line erected on these poles to provide communication between the different stations. The cost to date of the line, including right-of-way, is about \$9,000.00. When all accounts are paid, the cost will not exceed \$9,200.00.

The Commission constructed a transformer station in Penetanguishene in which were installed two 200 kv-a. transformers connected in open delta, and stepping down from the line voltage to 2,300 volts, three-phase for distribution by the Corporation. An automatic oil switch is provided where the line enters the station, and the equipment is protected with electrolytic lightning arresters.

Tenders were called and contracts awarded as follows:—

Transformers, Can. Crocker-Wheeler Co.	\$1,600
Switching & Protective Equipment, Can. Westinghouse Co..	2,550
Building, W. Blanchard, Penetanguishene	1,600

The building is constructed of red brick with a re-inforced concrete roof supported on steel beams. The general appearance and type of construction are the same as other stations of the Commission. In order to minimize operating costs, the station was located adjoining the pumping-station of the Corporation.

CHAPTER IV.

OPERATION OF THE SYSTEMS.

NIAGARA SYSTEM

The first actual operation of the Niagara System occurred on May 18th, 1910, when the 2,200 ft., 12,000 volt, lead covered, underground cables furnished by the Messrs. Siemens Bros. Dynamo Works, and connecting the Niagara Transformer Station with the Ontario Power Company, were placed in test operation. The test included the measurement of the resistance and capacity of the cables and also the application of 30,000 volts, for a period of five minutes, between each of the three conductors, as well as between the conductors and the lead sheath.

Some difficulty was experienced in obtaining a suitable equipment with sufficient capacity to test the entire length of cable at 30,000 volts, but finally a portable testing set belonging to the Westinghouse Company was secured and the test completed on May 23rd. All of the cables successfully withstood this test with the exception of one joint which was later satisfactorily remade.

The insulation resistance was measured by means of a 15,000 ohm Kelvin galvanometer operated with 75 dry cells, and found to vary from 225 to 325 megohms between the conductors and the lead sheath, whereas, the contract guarantees call for not less than 100 megohms. The insulation resistance between the conductors of the cables measured between two conductors at a time was 2,335 megohms.

The electrostatic capacity of the cables were measured with a 0.495 microfarad standard condenser used in conjunction with this same galvanometer.

The capacities of the cables were uniform and averaged 0.101 microfarad between individual conductors for the whole length of the cable.

The ohmic resistance of the cables was found to be 0.184 ohm per mile of conductor, at a temperature of 60 degrees fahr.

After the installation of apparatus and wiring in the different transformer stations, the following high voltage tests were made by the manufacturers of the apparatus.

The 110,000 volt transformers were first tested between the high tension windings and ground for a period of one minute at 220,000 volts. A double potential test was then performed by operating them for five minutes with 127,000 volts applied across the high tension terminals, and with the low tension windings open-circuited. This latter test was made to ascertain if any weakness existed between the individual turns of the coils. The transformers in all of the stations satisfactorily withstood these tests, although at the Guelph Station one of them developed a short circuit between turns immediately after the first application of line potential. However, this feature was occasioned by a spot in the insulation of one of the high tension coils which had not been properly dried, and the defect was immediately repaired by the manufacturer.

The high voltage test on the station wiring consisted of the application of 220,000 volts between each of the phases and ground for one minute, and was made to include switch bushings, station line entrances, and all parts of the wiring and switching apparatus, with the exception of the 110,000 volt electrolytic lightning

arresters which, in many cases, had not then been installed. The bushings of the high tension lightning arresters had previously been subjected to a 220,000 volt test at the factory, and it was therefore considered unnecessary to repeat the test at the stations.

The low tension wiring and busbars at the stations were tested at 27,000 volts between ground for a period of one minute. No trouble developed on the tests of the low tension wiring except that some of the porcelain tubes in the bus structures were found to leak over, and were at once replaced.

The first energy was delivered to the Niagara step-up transformer station from the Ontario Power Company at 12,000 volts on August 25th, 1910. On this and the several succeeding days tests at full voltages were made on the underground cables connecting with the Ontario Power Company's plant by starting at a low voltage and building up gradually to normal. In a few cases, higher voltages than 12,000 was attained in order to test the cables thoroughly. On September 4th, the 110,000 volt lines between Niagara and Berlin, by way of Dundas, Guelph and Preston, a distance of approximately one hundred miles were operated for the first time. Transformers were connected to the line only at Niagara and Berlin, and the test was started at a very low voltage as in the previous cases, and gradually increased during a period lasting approximately one hour, until 15,000 volts were obtained from the generators of the Ontario Power Company, and a voltage of approximately 148,000 volts attained between the conductors of the high tension line. The test was satisfactory in all respects. The only phenomena observed being the static or coronal displays on the line conductors and the high tension wiring of the stations. This was barely noticeable at 110,000 volts, but when a potential of 135,000 volts was attained, the aluminum cables suddenly emanated a distinct crackling sound. The line losses, measured by switchboard watt-meters at Niagara, were found to be 200 kw. at 110,000 volts and 2,200 kw. at 148,000 volts. Between the potentials of 135,000 and 148,000 volts the losses increased considerably faster proportionately than the voltage. Similar tests made in the dark showed that the line conductors became luminous simultaneously with the discharges at 135,000 volts, and developed greater luminosity as the voltage was further increased.

Tests similar to those just described were continued at intervals until October 11th, when energy was officially delivered to Berlin, although power for testing purposes had been supplied to the Berlin Municipal Station on September 6th. A celebration which was attended by City Officials from the towns in the Niagara District as well as by eminent engineers from all parts of the country, was held at Berlin on October 11th, 1910, in commemoration of the first energy being supplied to a municipality from Niagara Falls through the Hydro-Electric scheme.

Interesting addresses were given relating to the history of the Hydro-Electric project from the time of its inception to its successful issue, after which the energy was officially turned on in the auditorium, tastefully decorated with electric mottoes and the seals of the various Municipalities. A large portion of the hall was set aside for exhibits by various electrical manufacturers, and on the same evening an elaborate banquet was given, at the close of which speeches were made by various prominent representatives of the Commission and the different municipalities.

During the month of November, energy was supplied to the Municipalities of Guelph, Woodstock, Preston and Waterloo; and in December the municipalities of London and Stratford, and the Beach Pumping Station to Hamilton were connected to the system. London held a celebration similar to that at Berlin on

TYPICAL FALL LOAD CURVE

1911

H. E. P. C.
ONTARIO

HORSE-POWER

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P.M.

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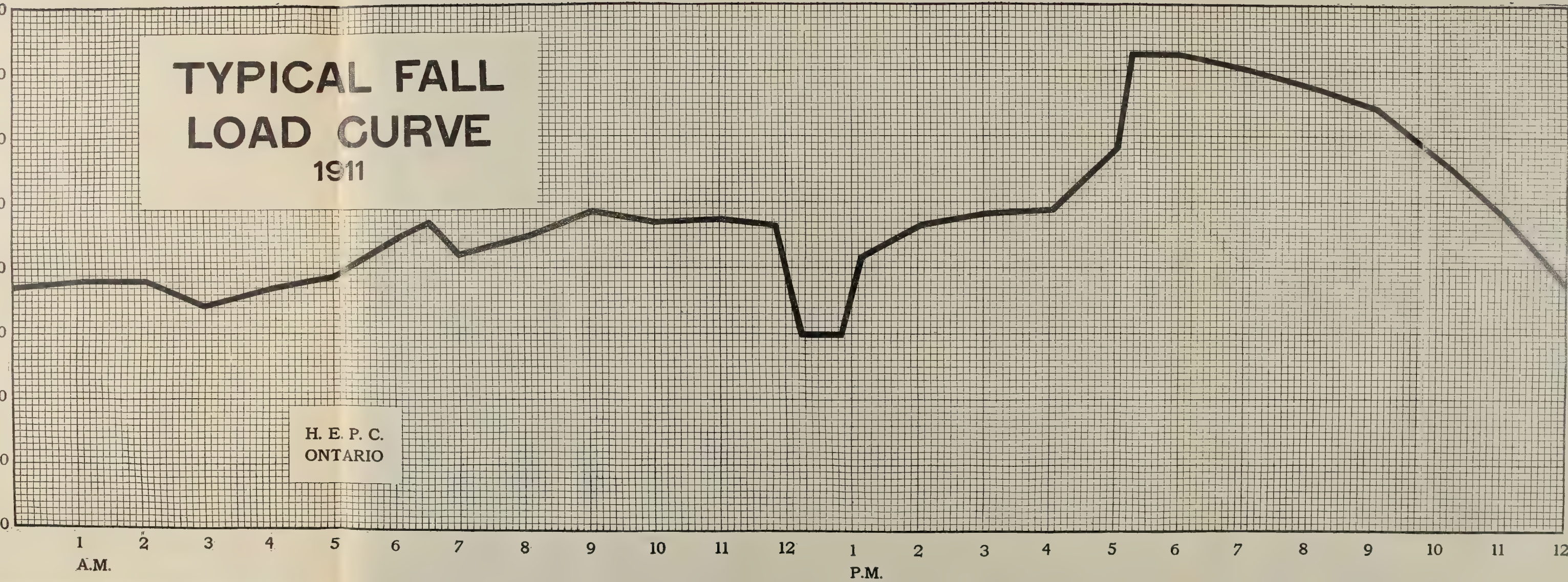
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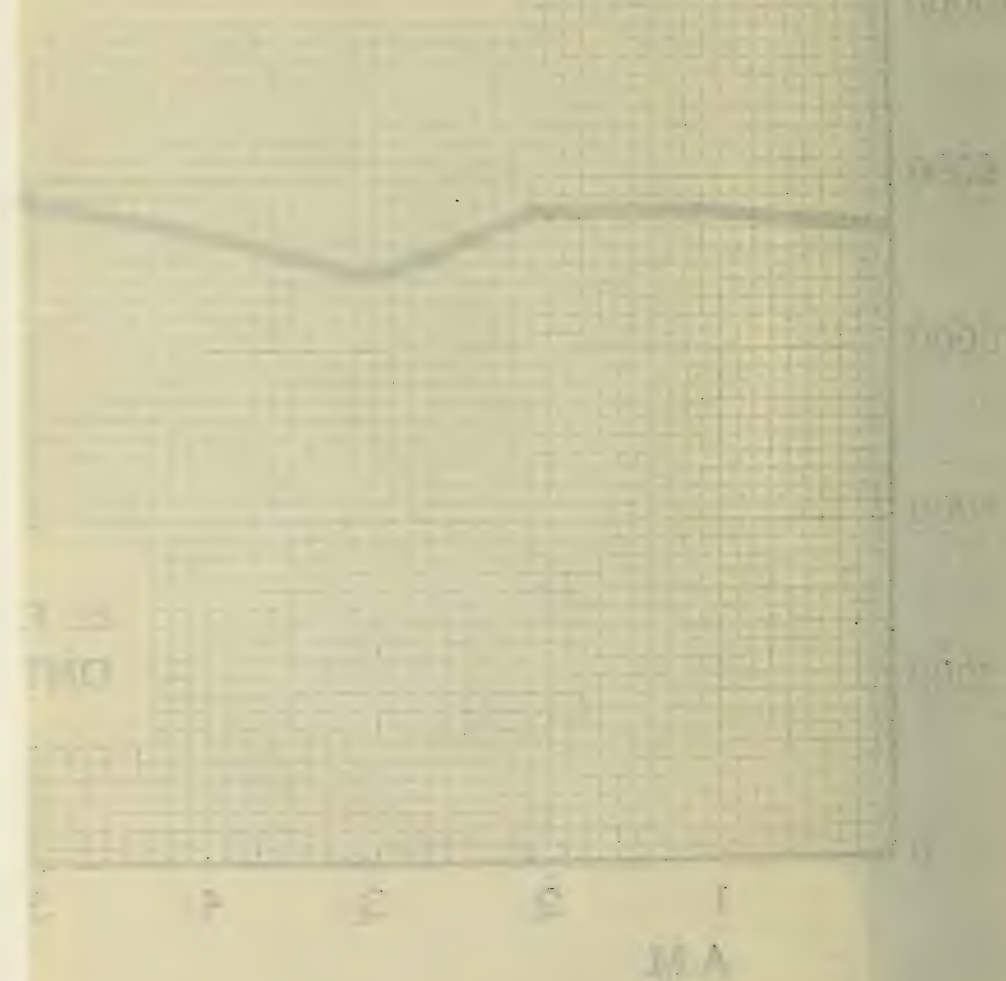
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TYPICAL LOAD

12



December 21st. The Municipalities of Dundas and Hespeler were connected in January, and in February St. Thomas and New Hamburg were supplied with energy. In the meantime, the high tension transmission lines had been completed to all points embraced in the original scheme. Energy was first delivered to Toronto Sub-station on February 24th. Toronto first took energy for lighting in March, at which date Galt was also connected. During the latter part of the month the Galt, Preston and Hespeler Railway was supplied Commission energy at their Berlin sub-station. Ingersoll was connected in May, and in July the Port Credit Brick Company and Tillsonburg contracted. Weston began using energy in August, and Mitchell in September, making in all twenty municipalities and two industrial corporations supplied by the system.

The following table shows the municipalities taking energy at the present time, the date of the first service together with the maximum load used the first month, and the maximum load for the month of October 1911. The probable requirements for energy by the municipalities during the early months of 1912 is also given.

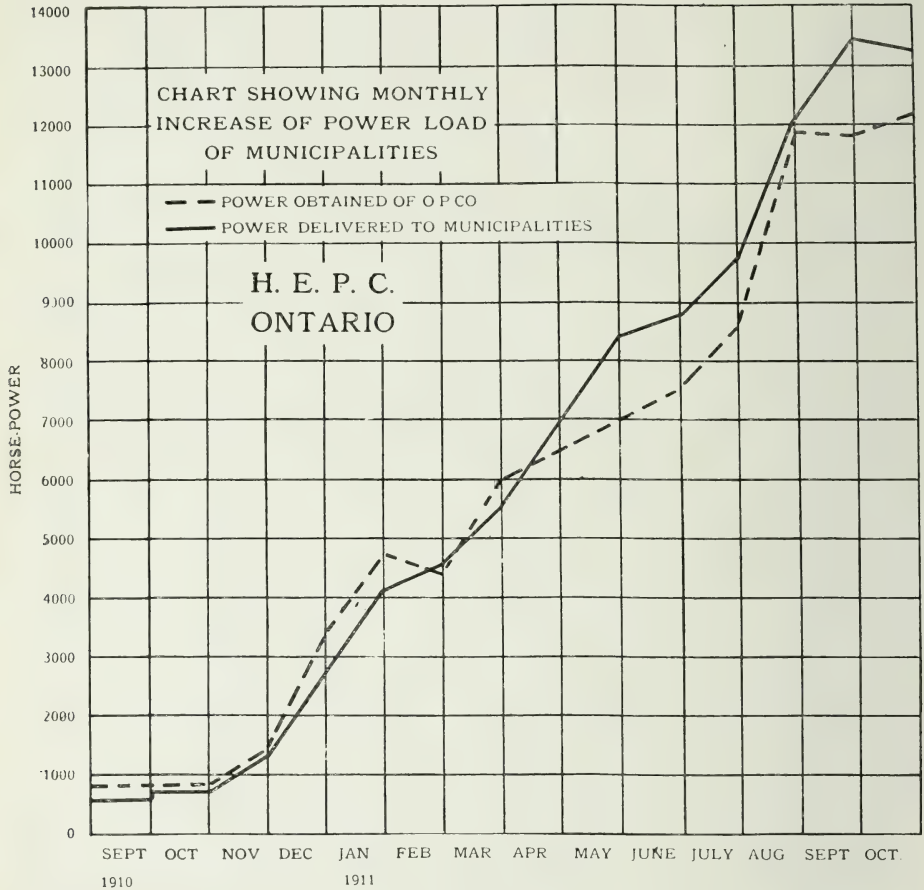
The amount of energy supplied by the Ontario Power Company during the month of October 1911 was 12,092.5 h.p., and the sum of the peak loads taken by the municipalities was 13,169.5 h.p., making an excess of 1,076.5 h.p. sold to the municipalities over and above that purchased by the Commission. This excess of energy varies from month to month because of the manner in which the different peak loads overlap, and also because the line losses vary with the weather conditions. During the winter months the peak loads taken by the municipalities are determined by the amount of energy required for lighting purposes, and are therefore more apt to coincide, thereby tending to reduce the excess amount of energy sold over that purchased.

Municipality	Date of first taking energy.	Max. load taken first month of operation.	Max. load Oct., 1911.	Probable load for 1912.
		h.p.	h.p.	h.p.
Berlin.....	Sept. 29th, 1910..	604	1,045	1,500
Guelph.....	Nov. 13th, 1910..	248	898	1,000
Waterloo.....	Nov. 13th, 1910..	167	241	350
Preston.....	Nov. 29th, 1910..	134	322	400
Woodstock.....	Nov. 30th, 1910..	450	804	1,000
London.....	Dec. 2nd, 1910..	805	1,609	2,200
Hamilton.....	Dec. 20th, 1910..	1,062	1,252	1,500
Stratford.....	Dec. 25th, 1910..	54	469	500
Hespeler.....	Jan. 5th, 1911..	87	201	200
Dundas.....	Jan. 2nd, 1911..	10	55	100
New Hamburg.....	Feb. 3rd, 1911..	100	107	110
St. Thomas.....	Feb. 22nd, 1911..	134	469	800
Galt.....	Mar. 15th, 1911..	80.5	335	400
Toronto.....	Mar. 24th, 1911..	805	3,318	6,000
C. P. & H. Ry.....	Mar. 27th, 1911..	334.5	536	500
Ingersoll.....	April 1st, 1911..	167.5	201	300
St. Mary's.....	April 21st, 1911..	134.6	241	350
Port Credit Brick Co....	June 18th, 1911..	469.5	670	670
Tillsonburg.....	July 1st, 1911..	53.6	127	200
Weston.....	Aug. 4th, 1911..	80.4	80	110
Mitchell.....	Sept. 11th, 1911..	147.5	168	200
Brampton.....	Oct. 16th, 1911..	21	21	200
Seaforth.....	.....	.....	.....	300
Waterdown.....	.....	.....	.....	160
Totals.....	.....	.....	13,164	19,050

An accompanying curve shows the manner in which the total load has increased since the beginning of operation.

The load factor of the system is fairly high and for eighteen hours of the day the average load is roughly 75 per cent. of the maximum. A typical load curve of total energy used during the fall months of 1911 is also shown.

Because of the extent of the high tension system and its high voltage there is an appreciable charging current taken from the Niagara Station, the power factor of which is very low, and leading in phase. At the beginning of operation when the load of the system was very light, the power factor at Niagara Falls was lower



than 70 per cent. leading. As the load has increased a large number of transformers, induction motors and smaller equipment have been added which, in themselves, produce a lagging power factor. As a result, the 85 per cent. leading power factor on the lines at Niagara will shortly change to a lagging power factor. A number of the municipalities have provided synchronous condensers to control the power factor of their loads. These municipalities are in this way enabled to keep their power factor well above the 90 per cent., the value specified in the contract. A number of the smaller municipalities, however, have not yet found it convenient to correct their power factor, and as a result, in some instances, it runs very low.

CHART SHOWING POWER CONSUMED BY MUNICIPALITIES.

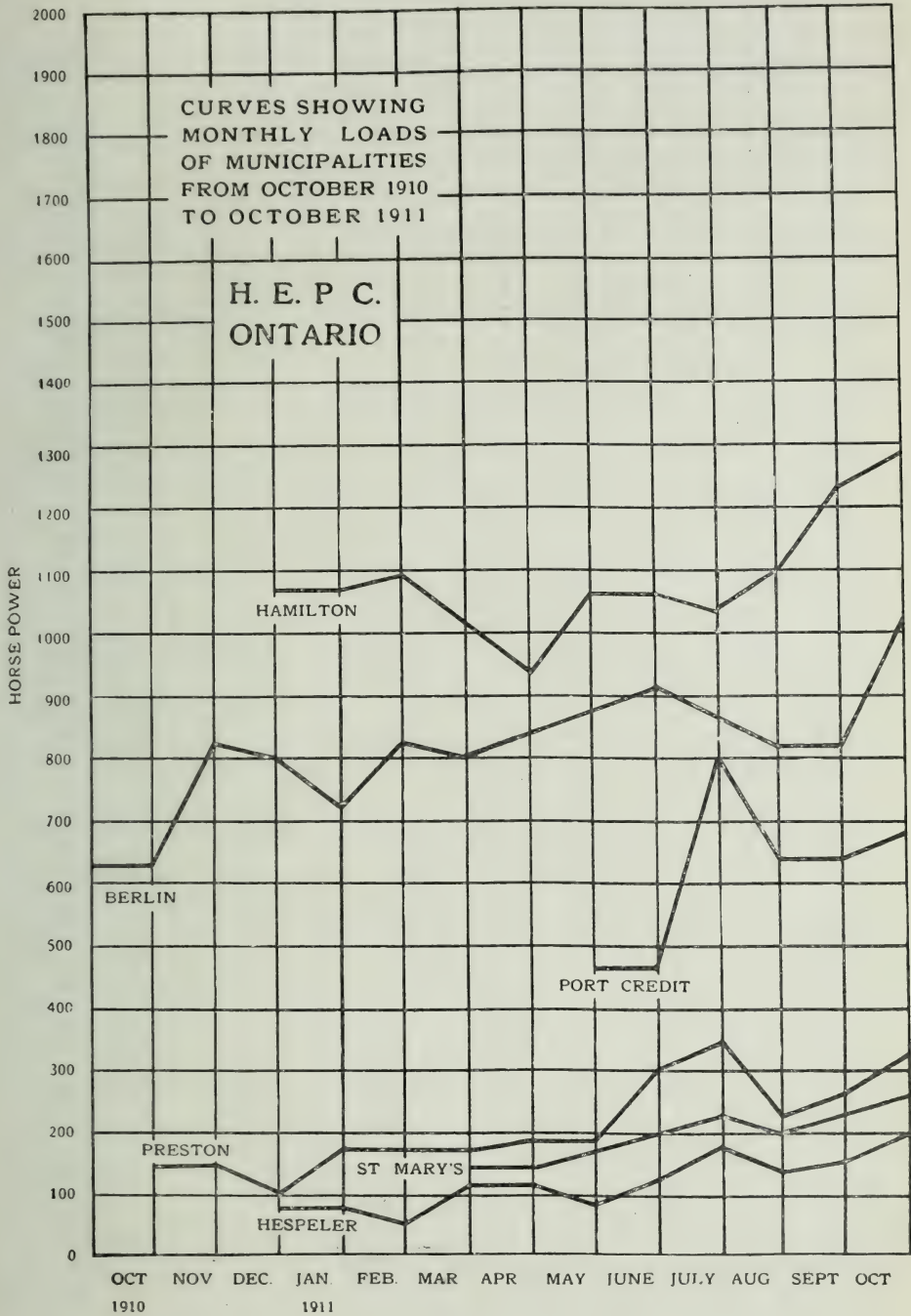


CHART SHOWING POWER CONSUMED BY MUNICIPALITIES.

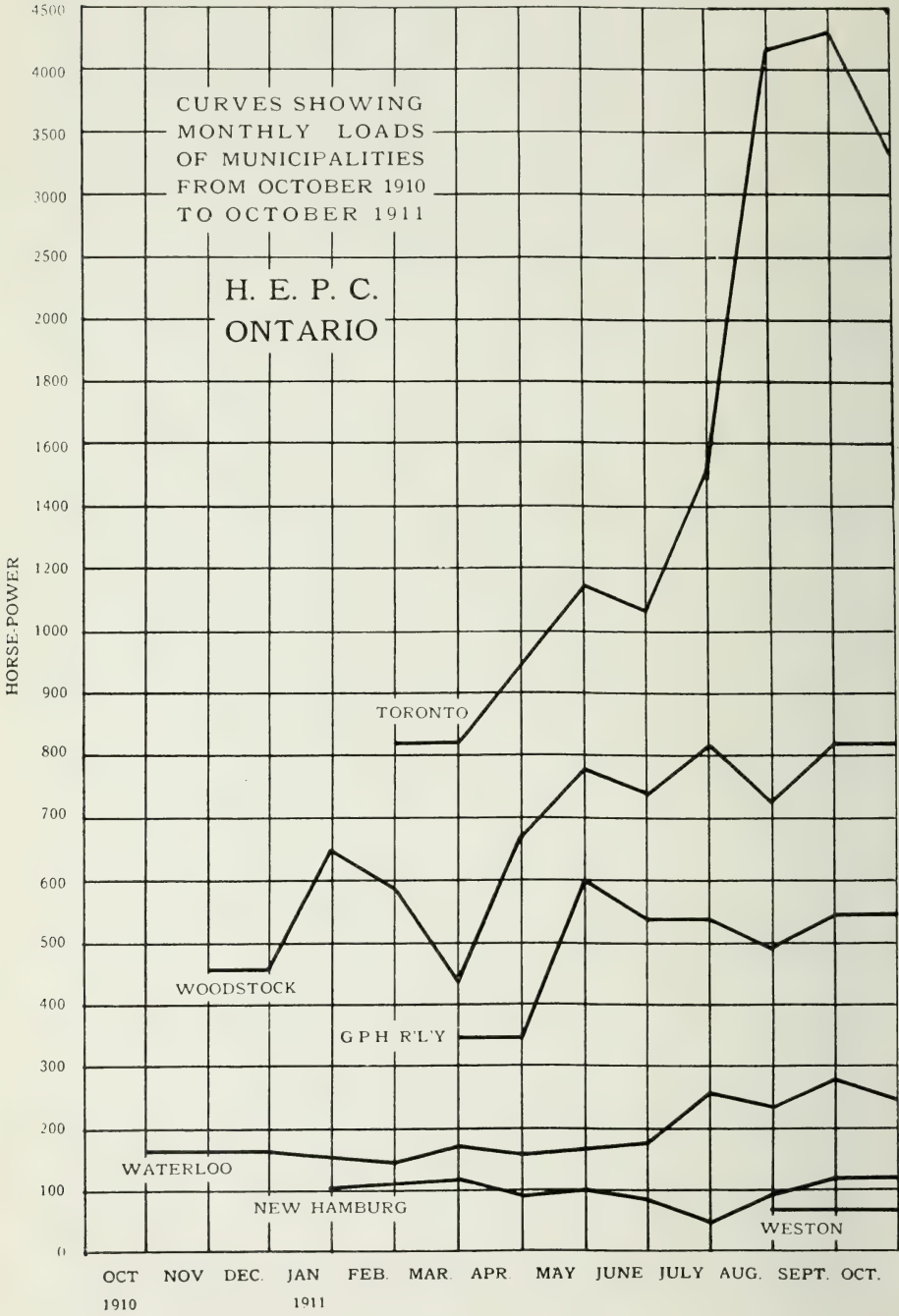


CHART SHOWING POWER CONSUMED BY MUNICIPALITIES.

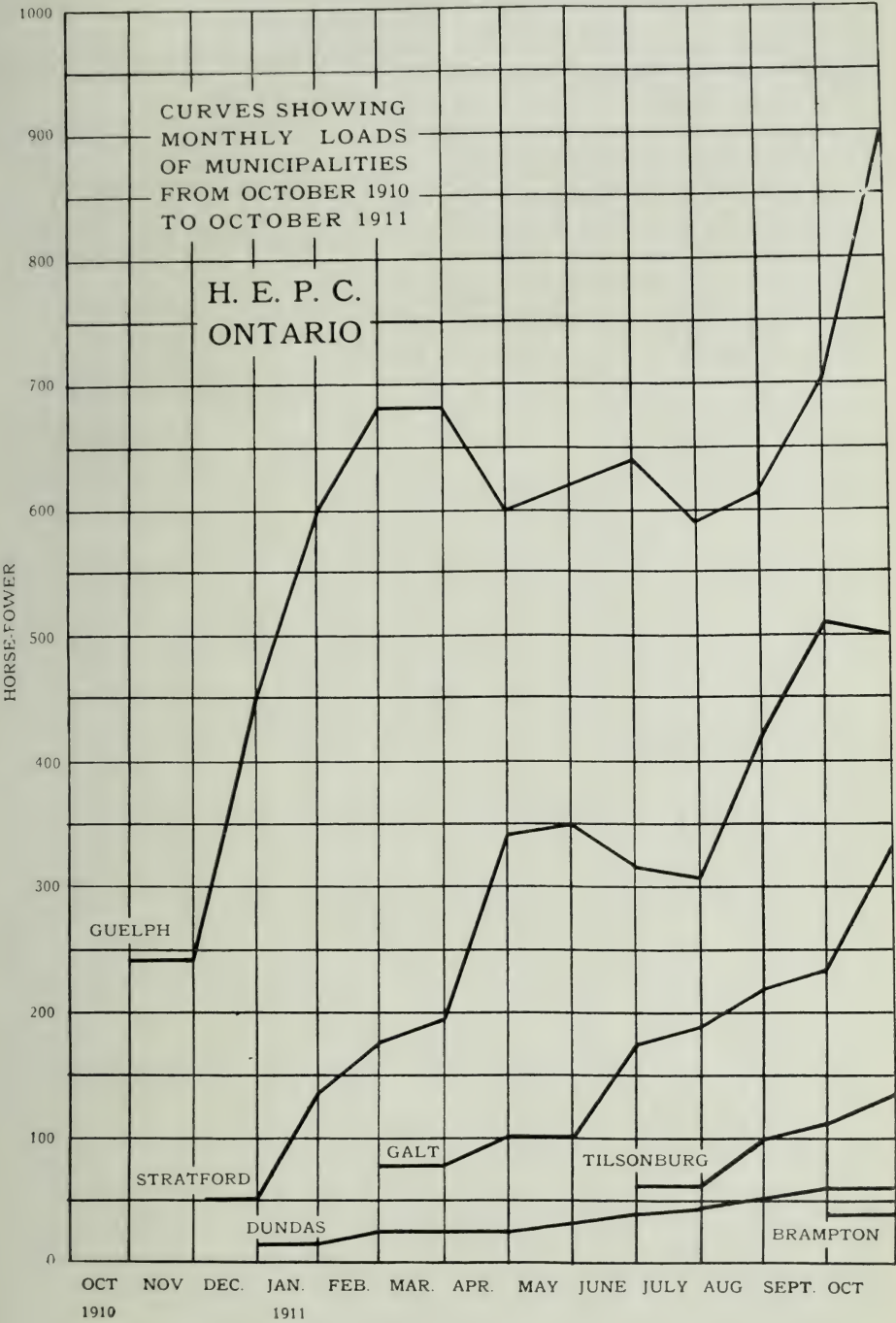
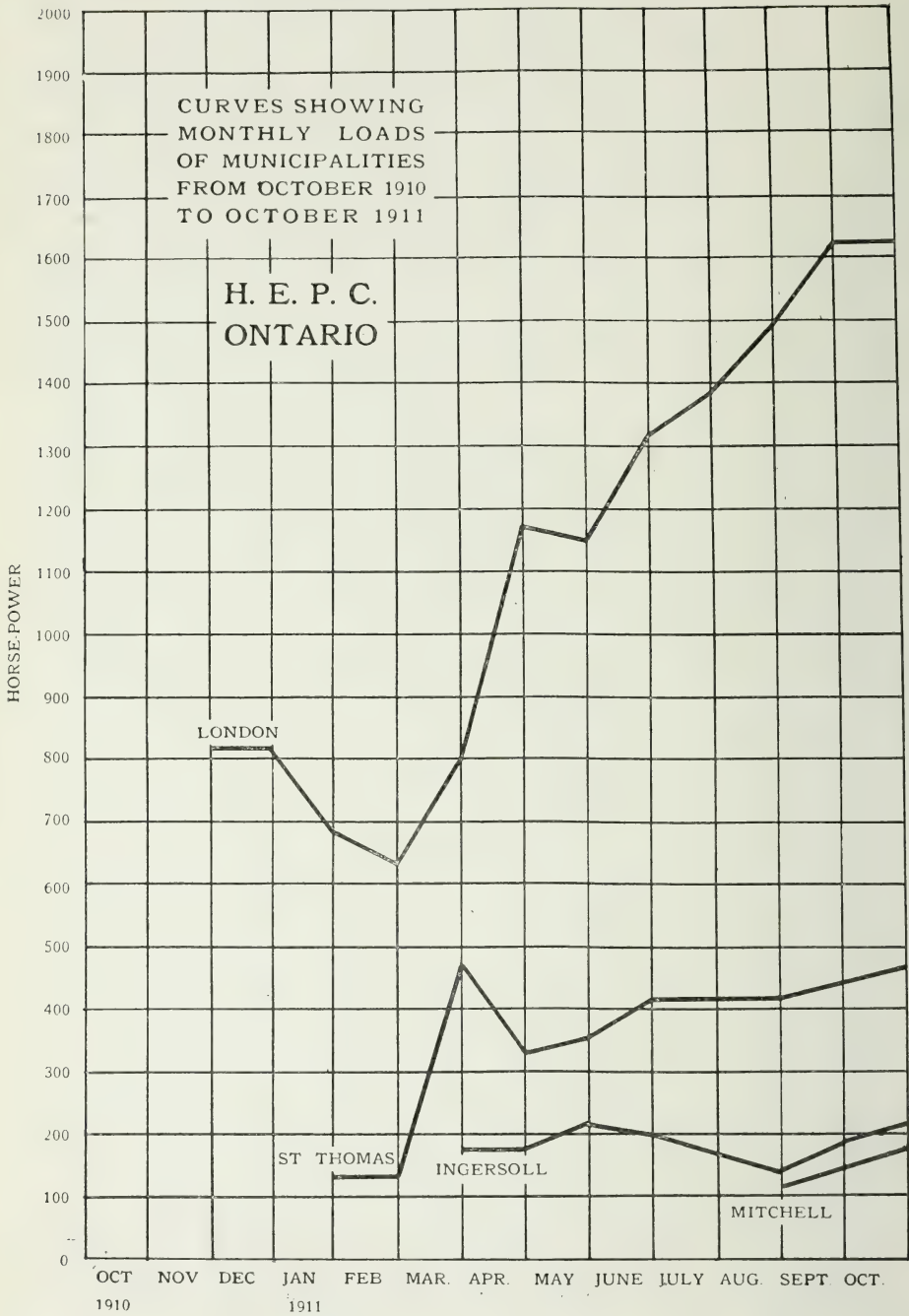


CHART SHOWING POWER CONSUMED BY MUNICIPALITIES.



The voltage regulation of the high tension system from no load to full load at the present time is less than 2 per cent., even when feeding the greatest distance around the loop. For instance, when the section of line between Dundas and Guelph is not in use the energy supplied at such times to the municipalities of Stratford, Berlin, Preston and Guelph must pass through Woodstock and London.

Although the regulation on the high tension system has been very good, a number of the municipalities have been inconvenienced by low voltage at times of the greatest loads because of the drop in their secondary circuits, which were not of sufficient size to provide for these loads. For this reason it has been necessary to supply several of the municipalities at voltages 5 per cent. higher than normal by means of extra voltage taps on the step-down transformers in the Commission's sub-stations.

The actual operation of the system was attended with certain difficulties at the beginning, as is to be expected with all large undertakings of this kind. A number of interruptions were caused due to changes in the adjustments of the line cables and ground wires, particularly during the winter months when it was difficult to re-adjust the cables satisfactorily. This trouble was confined to two sections of the line, but since these have been carefully gone over, the interruptions resulting from wind-storms on the high tension lines have ceased, and very little trouble is anticipated from these causes in future.

During the summer of 1911, electrical storms were reported on fifty-five different days, eighteen of these were severe, and the balance light or moderate. The first lightning storm of the season occurred on March 11th, and the last on October 4th. The majority of these storms were more or less general in their extent, but it is interesting to note that the greatest number were reported from the vicinity of Port Credit, and the fewest from Stratford. They occurred with the greatest frequency during the periods from May 17th to May 31st, and July 5th to August 18th, when scarcely a day passed without a report of storm at or near one or more stations. The storms of greatest severity occurred near the beginning and end of the lightning season, although there were a few during the early part of June.

Six interruptions have been caused directly by lightning on the high tension system, but comparative results on the operation of other lines radiating from Niagara Falls show that our high tension lines can be considered as being practically immune to the effects of lightning. No exact data is obtainable relating to the actual number and extent of interruptions on the other systems, but it is believed that our high tension lines have been effected at the most, only about one-quarter as much during the season as any other system either on the Canadian or American side of the Niagara District.

It is also interesting to note that out of the 120,000 high voltage insulator sections on the line, not one has been broken from electrical causes since the beginning of operation, although a few sections were broken during the first few months by rifle bullets.

Although a comprehensive description of the telephone system which parallels to the high tension lines will be found in another part of this report, it might be well to mention the difficulties which attend its early operation and the manner in which these difficulties have been gradually over-come.

Because of the proximity of the telephone wires to the high tension transmission cables, large currents are induced in the telephone wires whenever a change occurs in the electrical conditions on the transmission circuits. The telephone

apparatus would be frequently destroyed if some provision were not made to lead these heavy currents to the ground. Difficulty was first experienced with the burning out of the fuses in series with the telephone instruments and the fusing of the heat coils which were later tried. The failure of these protecting fuses always occurred at times when the telephone circuits were most needed, and frequently necessitated the employment of the Bell service to conduct the ordinary switching operations at the various stations.

Another difficulty which was also encountered at this time was the fouling of the lightning arrester gaps, which were composed of two blocks of carbon separated by thin strips of mica. The discharges across the arrester gaps were sufficient to dislodge particles of carbon from the blocks and bridge across the air gap. The result was either a ground on one side of the line or a complete short-circuit. Small vacuum type arresters were then tried, but it was found that the induced currents were so heavy that the arresters would soon deteriorate and become useless. Bleeding coils submitted by one or two telephone manufacturers were also found inadequate. Finally, one of the Commission's engineers designed an entirely new protective equipment which has been found very satisfactory in handling these large circuits. A description of this equipment is given in another part of this report.

PORT ARTHUR SYSTEM

The City of Port Arthur is supplied with energy purchased from the Kaministiquia Power Company at 22,000 volts. A wooden pole line four miles long has been built to connect the transformer station in Port Arthur with the lines of the Company. Energy is received at the sub-station at the above voltage and "stepped down" to 2,200 volts for distribution in the city.

The transformer station was finished the middle of December 1910, and the first delivery of energy was made on December 21st. The amount of energy taken since the beginning of operation has varied from 1,500 to 2,000 h.p., but this amount is expected to increase at least 50 per cent. within a short time.

This energy is used for the operation of the street cars in Port Arthur, for public and domestic lighting, and also largely in the grain elevators.

CHAPTER V.

HYDRAULIC INVESTIGATIONS.

SUMMARY.

Fort Frances.

Acting in accordance with a resolution passed by the Council of the Town of Fort Frances under date of February 15, 1910, the Hydraulic Engineer of the Commission was sent to Fort Frances with instructions to investigate conditions in connection with the export of electric energy from the Canadian side of the Rainy River, and also to ascertain as nearly as possible the costs of electric energy as developed on the Canadian side of the River by the Ontario and Minnesota Power Company. The conditions existing at that time are set forth in Report No. 1, hereto appended.

The official history of the Ontario and Minnesota Power Company apparently begins in the year 1904, when, on the 17th February, a contract was entered into between E. W. Backus of Minneapolis, and Thos. W. Gibson, the latter representing the Department of Crown Lands of the Province of Ontario. Under the terms of this contract, all property, riparian and water rights necessary for the full development of the Canadian portion of the Alberton Falls were conveyed to E. W. Backus for a cash consideration of \$5,000.00, and a covenant binding the said E. W. Backus to abide by certain conditions and restrictions designed to protect the interests of the Federal and Provincial Governments and the Municipality of Fort Frances.

In the following year, 1905, Mr. Backus again approached the Provincial Government, and without the knowledge or consent of the Municipality of Fort Frances, entered into a second contract under date January 9th, 1905, with the Hon. A. J. MacKay, representing the Department of Crown Lands of the Province of Ontario. These two contracts are identical, clause for clause, with the exception of Clauses 1 and 8. By virtue of Clause 1 in the 1905 agreement, a block of property forming part of the town site of the Municipality of Fort Frances, which was held by the Province, was conveyed to E. W. Backus. This was in addition to the property conveyed under agreement of 1904, and no additional compensation was asked. In Clause 8 of the 1904 agreement, it was stipulated that one-half of the total power capable of development should at all times be retained and reserved for use on the Canadian side. In Clause 8 of the 1905 agreement, it was stipulated that 4,000 h.p. only should be at all times retained and reserved for use on the Canadian side. It further stipulated that when the 4,000 h.p. reserved was in permanent use on the Canadian side, and additional power required should be provided if the same were not in permanent use on the American side of the River.

This 1905 contract was probably obtained by Mr. Backus in order to make better terms with the financial house of Peabody and Houghteling, of Chicago, to whom he assigned all rights held by virtue of this contract, for it was not

until the 13th January, 1905, that the Canadian Company was incorporated under the Ontario Companies Act, under the name of the Ontario and Minnesota Power Company.

During this said period Mr. Backus had acquired in fee simple, by virtue of warranty deed through United States Patents, all property, riparian and water rights necessary for the full development of the American portion of the Alberton Falls, and these rights were assigned in turn to a company called the Minnesota and Ontario Power Company incorporated under the law of the State Maine, with head office in the City of Portland, Maine.

During the same year the Canadian Company sought to strengthen its position by obtaining a Federal Charter. This it failed to secure but an enabling act, 4-5, Ed. VII. Chapter 139, was passed in its stead, by virtue of which the Company was granted power to develop the Canadian water power under certain conditions.

This Act stipulates in brief that : (1) power whenever developed shall be developed concurrently on the Canadian and American sides, respectively; (2) power used in Canada shall be developed in Canada; (3) the Company shall be under the jurisdiction of the Dominion Railway Board, and no power developed in Canada shall be diverted for use in the United States without an Order of the Board. The Board also has power to fix the time during which such diversion may continue, and if necessary to regulate the price for which power is to be sold.

An Act, Ontario Statutes 1906, Chap. 132, was assented to on May 14th, 1906, at the petition of the Town of Fort Frances, which purported to set aside the agreement entered into between E. W. Backus and Hon. A. G. MacKay, in January 9th, 1905. This Act stipulates that notwithstanding provisions to the contrary in the 1905 agreement above mentioned, certain conditions and restrictions as enumerated in the text of the Act are to be adhered to and observed by the developing company. These conditions and restrictions are substantially the same as those laid down in the Dominion Act of 1905, with the exception that the powers vested in the Dominion Railway Board under the Dominion Act, are in the Ontario Act vested in the Lieutenant-Governor-in-Council of Ontario.

Such was the condition of affairs when construction work was started. Plans were employed which had been prepared in accordance with the provisions of the Dominion Act of 1905, and the Provincial Act of 1906, and provided for two power houses of similar construction and equal dimensions with an equivalent number of power units identical in design and capacity.

Construction was continued under the original plans until the summer of 1908, when the agitation for Tariff Reform and the usual period of unrest preceding a presidential election caused a suspension of work, since the company feared an increase in the duty on pulp wood and other allied products as well as possible retaliatory measures by Canada.

During this period of inaction the idea was conceived of placing all the pulp and paper making machinery necessary for the operation of a 200 ton mill on the American side, and the necessary electrical equipment on the Canadian side, thus making the Company's manufactured products independent of the tariff as regards the American market. The idea was acted upon, with the result that the plant as at present installed, has on the American side six 2,250 h.p. wheels direct connected to pulp grinders, and on the Canadian side four 1,700 h.p. wheels connected to electric generators. The present installed wheel capacity is, therefore, 13,500 h.p. on the American and 6,800 h.p. on the Canadian side.

There is apparently no documentary evidence to show that the company was officially authorized to install the plant in the manner just described, and if such evidence does not exist, the company's action is plainly a direct violation of the Clauses 2 and 3 of the Dominion Act, and Clauses 1 and 2 of the Provincial Act, the meaning and interpretation of these Clauses being unmistakable.

In the meantime, work on the paper-mill on the American side was being carried to completion, and early in 1910 the plant was ready for operation. The company therefore, applied to the Federal and Provincial Governments for a license to export 6,000 electrical h.p. from the Canadian plant. The Dominion Railway Board, acting under Clause 5 of the Dominion Act of 1905, gave the necessary permission in Order No. 9,326 under date of January 18th, 1910, and under date June 11th, 1910, the necessary license No. 21 was issued by the Department of Inland Revenue. This license is revocable at will and permits the Company to export power during the year ending March 31st, 1911. After careful consideration the Lieutenant-Governor-in-Council acting under Clause 4 of the Provincial Act of 1906, issued a permit for the export of 6,000 h.p. Conditional upon receiving this permit the company entered into an agreement with the Minister of Lands and Mines under date June 2nd, 1910.

This agreement stipulates that the Government can revoke the export license at any time, and also that all matters relating to contracts, distribution, power costs, etc., be fixed from time to time, or when necessary, by the Hydro-Electric Power Commission of Ontario. The company is at the present time using Canadian power in the paper-mill on the American side under authority of the above mentioned permits.

The action of E. W. Backus with reference to 1905 agreement and subsequent acts of himself and his associates gave rise to a feeling of distrust and caused some anxiety as to the Company's motives among the people at Fort Frances. Matters came to a head when the Company quoted a price for energy which the Mayor and Council of Fort Frances considered exorbitant, and not in accordance with the terms of the 1904 agreement between E. W. Backus and the Commissioner of Crown Lands.

Negotiations finally reached a stage when Mr. Backus agreed to allow the Minister of Lands and Mines to set a price at which power was to be sold on the Canadian side. A resolution was also forwarded to the Hydro-Electric Commission by the Mayor and Council of Fort Frances asking that an investigation be made with the view of establishing a fair rate for power.

Acting under the conditions of the agreement of June 2nd, 1910, the Consulting Engineers of the Commission were instructed to procure the necessary facts and data and prepare a report dealing with the cost of power on the Canadian side.

For this purpose two engineers were sent to Fort Frances with instructions to obtain from the Power Company such costs, data and other materials as might be necessary for the preparation for the complete report. Sufficient information and data was obtained to enable the consulting engineers of the Commission to prepare their report, which is appended hereto. (See Report No. 2.)

Thessalon.

The Municipality of Thessalon applied to the Commission in March, 1910, for information in connection with the development of power on the Thessalon River for municipal and industrial purposes. This matter is dealt with in Report No. 3, hereto appended.

Wingham.

In May, 1910, a resolution of the Council of the Town of Wingham was forwarded to the Commission requesting that a survey be made of a water-power about five miles from the town, together with a report on available capacity and cost of development. Surveys were made and plans forwarded to the Clerk of the municipality, but owing to the lack of hydraulic data, no estimates of capacity or development cost could be made at the time. Periodic measurements of discharge, however, have since been made which will enable the report to be completed in the near future.

Mississippi Storage.

In March, 1910, the power users on the Mississippi obtained legislative consent to the formation of a limited company called the Mississippi River Improvement Company, for the purpose of building storage dams in the upper watershed to regulate the flow for power purposes. The enabling act stipulated, among other things, that the location and construction of storage dams was subject to the approval and consent of the Hydro-Electric Power Commission. In September, 1910, the company submitted plans for the construction of the dams at Gull and Long Lakes, which were approved. (See Report No. 4.)

Pursuant of the Commission's approval, contracts for the construction of these dams were let, and in October, 1910, work was commenced at Long Lake. (See Report No. 5.)

The Long Lake dam was completed before winter set in, and the Gull Lake dam was completed the following spring. Since then no further construction has been attempted.

Renfrew.

In the fall of 1910, the flow of Bonnechere River reached such a low stage that most of the industries in the town of Renfrew suffered severely owing to the shortage of hydro-electric power. Upon application by the town a report was submitted in which it was recommended that low water conditions be relieved by means of artificial storage, and approximate figures were supplied to show the extent to which the Bonnechere River would benefit from such storage, with special reference to the storage possibilities of Round Lake and Golden Lake. (See Report No. 6.)

In February and March, 1911, a detailed survey was made of Round Lake to determine the maximum amount of storage which it was capable of providing, and the extent of land damages. A site for a storage dam was also selected, carefully cross-sectioned, and bed-rock was located by means of test pits. A detailed report (see Report No. 7) was then prepared giving the probable cost of dam construction and the land damages, and also outlining a general scheme for the complete development of the storage possibilities of the Bonnechere watershed.

Simcoe Railway and Power Co.

In September, 1909, this company secured a Crown lease covering the development of power at the Big Chute on the Severn River to the full capacity of the site, the primary object being to transmit power at 25,000 volts to the Towns of Midland and Penetanguishene. In November, 1910, when the works were approaching completion, an inspection of the same was ordered by the Commission. (See Report No. 8.) The Towns of Midland and Penetanguishene at this time made

application to the Commission for a supply of power, and as the plant of the Simcoe Railway and Power Company was the best available source of supply, the Commission opened negotiations with the company with a view to obtaining a contract for power. Using the actual cost records of the company as a basis, estimates were prepared showing the capital cost of the present partial development, and the probable cost of development for full capacity. Based on these costs, estimates were prepared showing the annual cost of various quantities of high tension and low tension power delivered at Midland. The contract between the Commission and the Power Company was based on these costs and signed in February, 1911. Since July, 1911, the Commission has been supplying power to the Towns of Midland and Penetanguishene under this contract. A copy of the contract will be found in that portion of this report dealing with municipal contracts.

Lindsay Light, Heat and Power Co.

In January, 1911, certain circumstances arose which led the Power Company to make an offer to sell their generating plant and transmission system to the Town of Lindsay for \$250,000. Acting by request on behalf of the Town, the Commission obtained an option on the property for \$230,000, and submitted a report on the plant as well as a report dealing with the proposed purchase by the municipality. (See Report No. 9.)

Peterboro.

In January, 1911, the Industrial Commission of Peterboro obtained from the Otonabee Power Company an offer to sell their plant to the City for \$225,000, and the Commission was asked to advise the town as to the feasibility of taking over the plant at this price and supplying cheap light, heat and power to the city. The question was carefully investigated and the conclusions arrived at are set forth in Report No. 10, hereto appended. In this Report, the general power situation in the City of Peterboro' is discussed, as is also the feasibility of a project on the part of the city to purchase or otherwise acquire control of all the water-power on the Otonabee River between Nassau and Lakefield.

Lakefield.

The Village of Lakefield applied to the Commission for estimates on the cost of 400 h.p. delivered in the village in January, 1911. It was considered that this problem had best be taken up in conjunction with the project of the City of Peterboro' to acquire control of the water-powers on the Otonabee River between Nassau and Lakefield, as the Village of Lakefield could obtain cheaper power under this scheme than it could from independent purchase or development. (See Report No. 11.)

Erindale Power Co.

The Erindale Power Co., having made application to the Commission for a supply of such power as they would require over and above that which they developed themselves on the Credit River at Erindale, the chief engineer of the Commission was instructed in January, 1911, to examine the plant and report on the same, with special reference to its hydraulic capacity. (See Report No. 12 hereto appended.)

Dog Lake Storage Dams.

In March, 1911, the Ontario Department of Public Works which had charge of the construction of the Dog Lake storage dams, received notification from the contractor that he had completed the work called for in his contract. The engineer of the Department of Public Works was sent up to Dog Lake to inspect the work, and the chief assistant engineer of the Commission, who was in Port Arthur at the time, was instructed to accompany him and report on the work to the Commission. (See Report No. 13 hereto appended.)

The Commission's Hydraulic Engineer visited the dams in June, 1911, to ascertain the best means of obtaining records of water level and sluice openings for the purpose of compiling hydraulic data relative to the Dog Lake watershed. As a result of his investigations, the permission of the Ontario Department of Lands, Forests and Mines was obtained to employ one of the Department's fire-rangers to keep records at the dams, and in July an engineer of the Commission went up to Dog Lake to set the necessary guages and give the fire-ranger all necessary instructions in the matter of keeping records. He also went up to the head of the lake to the mouth of the Dog River, where it was reported that an Indian Village was in danger of being flooded by the rising water. His report, No. 14 hereto appended, also mentions the fact that the gate-rod on one of the sluices had buckled, allowing one of the gates to be forced open. This was reported to the Department of the Public Works, and steps were taken by the Department to have the defect remedied.

The Dog Lake storage dams were built for the purpose of regulating the flow from Dog Lake, which has an area of 53 square miles, in such a way as to ultimately provide as nearly as possible a uniform rate of flow for power purposes in the Kaministiquia River.

At the present time the Kaministiquia Power Co., of Fort William, is the only organization to benefit from this regulation, and this company has been allowed, temporarily, to supervise the opening and closing of the regulating gates.

Waddington.

The Commission entered into a contract in April, 1911, with the New York and Ontario Power Company, covering the supply of power for the eastern municipalities up to a maximum of 15,000 h.p., which is to be supplied from a projected development in the Village of Waddington, situated on the American side of the St. Lawrence River, opposite the Town of Morrisburg. Report No. 15, hereto appended, deals with the physical characteristics of the power site and discusses the projected scheme of development from the standpoint of reliable and continuous service.

Maitland River.

In April, 1911, the officials of the County Council of Huron proposed that the County acquire the rights of the Maitland River Power Co., and develop power on the Maitland River, on condition that the Commission would purchase the power thus developed and distribute the same to the various municipalities throughout the County of Huron, and at seasons of the year when the Maitland Power was inadequate to meet market requirements, to make good the shortage by means of power supplied from the Niagara Distribution System. In this way it would be possible to distribute Maitland generated power throughout the district for the greater portion of the year, and use the Niagara System as an auxiliary

during periods of low-water flow. The principle of the scheme commended itself to the members of the Commission, and the chief engineer was instructed to investigate the matter thoroughly and report at the earliest possible date. Due to the lack of available data with reference to the flow characteristics of the Maitland River, it was impossible to prepare a final report at that time, but Report No. 16, hereto appended, was submitted with the object of indicating in a general way how the scheme might be handled.

Steps were taken in the meantime to investigate the flow characteristics of the river, and since May, 1911, monthly measurements of flow have been made and daily records of water-level kept. This work is still under way and will be continued at least until after the spring flood of 1912. With the data which will then be available, it will be possible to prepare a fairly authentic report on the economic feasibility of the scheme.



"Mohr's Chute," Chats Falls, Ottawa River.

Beaver River.

The Beaver River is to the County of Grey what the Maitland River is to the County of Huron, namely, the nearest and cheapest source of hydro-electric energy. Anticipating that in the near future, Owen Sound, Collingwood, and other Georgian Bay towns would require power, instructions were given for the preparation of a report dealing with the possibility of supplying these towns with locally generated hydro-electric energy.

A possible source of power was, therefore, ascertained to be Eugenia Falls on the Beaver River, which is at present owned by the Georgian Bay Power Co. This property was examined and through the courtesy of the company's secretary, the Commission's engineer had access to all cost estimates and weir records in the possession of the company.

With this information available, a preliminary report was prepared dealing with the power capacity of the site, the storage possibilities and development costs. (See Report No. 18 hereto appended.)

Orillia.

A series of accidents and the inefficient operation of their municipality owned power system threatened the Town of Orillia with a serious power-famine during the fall and winter of 1911. The town made application to the Commission in April, 1911, for assistance, and a report was prepared describing existing conditions and making recommendations as to the possible remedy, the whole being set forth in Report No. 19, hereto appended.

Englehart.

The municipality of Englehart, by resolution of the Council, asked the Commission in March, 1911, to report on the possibility of developing a water-power on the Blanche River for municipal purposes, giving estimates of capital and annual costs. A request was also made for a report on a proposed agreement between the town and a party wishing to acquire an exclusive franchise for the sale of light, heat and power in the municipality. (See Report No. 20, hereto appended.)

Department of Agriculture.

Acting on the request of the Ontario Department of Agriculture, an examination was made of a small water-power on the Driftwood River, the object being to ascertain if it could be economically developed for the use of the Government experimental farm at Monteith, to which the power site is adjacent. Report No. 21, hereto appended, covers the power capacity of the site and an approximate estimate of the capital cost of development, and the annual cost of power.

Brampton.

The Town of Brampton applied to the Commission in May, 1911, for an estimated valuation of the plant and system of the Brampton Electric Light Co., which was to be used as a basis of purchase by the town.

Huntsville.

The Town of Huntsville, through the Minister of Lands, Forests and Mines, applied for information as to the probable cost of power delivered in Huntsville from the Gravenhurst Municipal Plant at South Falls on the Muskoka River, in May, 1911.

Investigations by engineers of the Commission resulted in the preparation of a Report, No. 23 hereto appended, which recommends High Falls on the north branch of the Muskoka River as the source of power best suited for the immediate requirements for the Town of Huntsville, and also outlines a scheme for the future tying-in and consolidation of all the power sites on both branches of the Muskoka River capable of economic development.

Almonte.

The Town of Almonte requested an investigation in May, 1911, of its power situation, with a view of ascertaining the cost of developing the total head on the south branch of the Mississippi River, and the best means of consolidating the

various interests operating thereon in such a way as to make possible the development of the total head by the municipality. These matters are set forth in Report No. 24, hereto appended, as is also a description of the peculiar condition which exists as regards the division of water between the north and south branches of the Mississippi River within the corporation limits of the municipality.

Chesley.

In accordance with a resolution passed by the town council, the Commission's hydraulic engineer visited Chesley in June, 1911, to investigate the feasibility of a projected scheme to develop power on the north branch of the Saugeen River for the use of the municipality. Owing to lack of hydraulic data, it was not possible to prepare a reliable estimate of power capacity or cost of power. Since June, however, regular measurements of flow have been made and a fairly reliable report can be submitted when the high and low water conditions during the present summer and the coming winter have been ascertained.

Lindsay.

The Town of Lindsay requested the Commission in July, 1911, to investigate the possibility of developing the water-power on the Gull River at Minden, with a view to utilizing it at some future time as a source for an auxiliary supply to the town. The site was examined by an Engineer of the Commission, and a careful contour survey made. Discharge measurements will also be taken during the coming winter, since a proper estimate of cost and capacity cannot be prepared until the conditions of winter flow have been ascertained. A power-site on the Black River was also investigated, but the small volume of flow and the transmission distance precluded the possibility of using it as an economical source of auxiliary supply for the town.

Ottawa.

The Commission's Hydraulic Engineer spent two weeks during July, 1911, in Ottawa and the surrounding territory collecting data and information in connection with various water-powers which could be economically developed to supply the needs of the Municipality of Ottawa and recommending a site for the city to acquire if considered advisable. A report, based on the information obtained, is being prepared at the present time.

Eastern Power District.

Considerable attention has for several months past been given to the question of deciding upon a suitable source of power for the eastern municipalities, and at present the choice lies between High Falls, on the Madawaska, and the Waddington site on the St. Lawrence, previously referred to. An engineer of the Commission was also sent in July, 1911, to investigate the power possibilities of the Rideau watershed, but the information obtained indicated that there were no power sites in the Rideau district of sufficient magnitude to be used as a continuous source of power for the Eastern Municipalities. (See Report No. 25, hereto appended).

Hydraulic Surveys.

During the past year surveys have been made in connection with the following rivers: Bonnechere, Maitland, Saugeen, Gull and Sable.

The Bonnechere storage survey was made in February and March, 1911, and undertaken for the purpose of ascertaining to what extent the flow characteristics of the Bonnechere River could be improved by artificial storage. During the six weeks the party worked a complete survey of Round Lake and a partial survey of Golden Lake was made, and dam-sites at the foot of each lake were located, cross-sectioned and tested for rock. Altogether about thirty miles of line was run and flood contours established. The contour work was very difficult at times owing to deep snow and thick timber and undergrowth.

The Maitland River survey was undertaken for the purpose of checking the plans furnished by the Maitland River Power Co., in connection with the purchase scheme suggested by the County Council of Huron, previously mentioned in this report. Levels were run about four miles up the river from the proposed site of the dam, and the extent of back-water and the flood contours were found to check satisfactorily with the plans furnished by the Company.

Anticipating the possibility of power development on the Saugeen River by the County of Bruce, the river was examined for the purpose of locating a favorable site for development. It was found that the development of sixty foot head was possible in the vicinity of Port Elgin, and a survey was made of the site with all necessary levels and cross-sections. The flow of the river has been measured periodically during the summer, and measurements will be continued during the winter.

In connection with the proposed scheme of development at Minden, on the Gull River, a detailed contour survey was made to ascertain the maximum head obtainable and determine possible land damage and cost of construction. As previously mentioned, the working out of this scheme is being held over until some data has been obtained relative to the winter flow of the river.

The town of Wiarton, having made application to the Commission for a supply of power, the watershed of the Sable River was examined for the purpose of ascertaining whether sufficient power could be developed at Sable Falls, with the help of storage, to meet the requirements of the town. All lakes in the water-shed were visited, and their outlets examined for the purpose of locating sites for storage dams. It was found that while the lakes had considerable storage capacity, the ultimate power capacity was small owing to the restricted area of water-shed.

Relative to the project to construct a hydraulic accumulator plant at Dundas, a survey was made for the purpose of laying out a reservoir system and locating a power house and pipe lines. The site selected was carefully surveyed and cross-sectioned, and plans prepared were taken to Europe by the chief engineer to lay before continental experts.

James Bay Watershed.

Since June, 1911, an engineer of the Commission has been engaged in making a reconnaissance survey of the principal rivers of Ontario flowing into James Bay. Up to the present time he has worked on the Abitibi, Mettagami and Missinaibi Rivers, and the work will be continued during the coming winter. Discharge measurements are being made on all rivers as frequently as possible, and all important power sites are being surveyed. Various locations already being developed or about to be developed are also being examined and reported upon in detail. When sufficient information has been collected, a special report covering the James Bay water-shed will be prepared.

REPORT NO. 1.

Fort Frances.

As per instructions, the Commission's hydraulic engineer visited Fort Frances last week, to investigate the power question relating to the Minnesota and Ontario Power Company and the Town of Fort Frances.

On arriving it was found that there was no need for an estimate on the cost of distribution as the town already has its municipal system built and operating, debentures for \$10,000.00 having been issued to cover the expense. This system is employed for arc and residential lighting only, since there is no power load at the present time.

The scope of the investigation was, therefore, covered by the following items:—

(1) To obtain from the power company or determine by other means a definite price for which power could be sold to consumers on the Canadian side, said price to be published by the Town of Fort Frances as an inducement for the establishment of industries.

(2) Whether or not the Power Company be allowed to export power from the Canadian side.

(3) Reasons for prohibiting export of power.

(4) Conditions under which export might be allowed.

Cost of Power.

Due to the difficulty experienced in procuring actual costs from the company, the price of power can only be estimated from such general figures as were obtainable.

In August, 1908, J. S. White & Co., of New York, made a report on the Industrial Development at Fort Frances, which contains estimates on several proposed schemes of development. Plan "B" of this report is the one now under construction and entails the completion of permanent works for full capacity and the installation of sufficient hydraulic, electrical, paper-making and pulp grinding machinery to equip a plant with a daily paper output capacity of 200 tons. This plant is estimated to require 15,000 h.p. Taking the White Co. figures, the capital cost of permanent works for full capacity (36,000 h.p.) and power-house and equipment for 18,000 h.p., would be covered by the following items:—

Value of work completed to August, 1908	\$750,000
Completing dam and buildings for hydraulic plant	521,000
Hydro-Electric equipment for 45,000 kw.	79,500
Hydraulic equipment for pulp-mill	125,000
Total	\$1,475,500

In the above estimate are included three 2,200 h.p. wheels connected to generators, and six 2,200 h.p. wheels connected to pulp-grinders.

Annual charge on above investment would be approximately as follows:—

Annual interest, 6 per cent.	\$88,500
Sinking Fund (30 years), 1.8 per cent.	26,500
Annual repairs, 2 per cent. on permanent works	25,420
Annual repairs, 5 per cent. on equipment	10,225
Operation	9,000
Administration	15,000
Total	\$174,645

Average cost per h.p. per year of mechanical and electrical power on basis of 18,000 h.p. installed capacity, \$9.70.

It appears from another portion of the report that 4,500 kw. electrical capacity is sufficient for a 400 ton mill, so that 2,300 kw. should be sufficient for the present projected capacity. There would, therefore, be a surplus of 2,200 kw. available for independent use, which could be sold at the switchboard for \$9.70 without loss.

In plan "D" of the same report is an estimate covering the cost of a complete hydro-electric development for the full capacity of the site.

The title of this estimate is significant, reading as follows:—"Cost to complete the development providing for all the power (Canadian and American) to be used for generating electricity and *transmitting it to the mining district of Minnesota.*"

Using this estimate the capital cost of a hydro-electric plant of 32,000 h.p. capacity would be covered by the following items:

Value of work completed to August, 1908	\$750,000
Completing dam and buildings for plant	650,000
Hydro-Electric equipment	571,500
Contingencies	40,000
Total	\$2,011,500

Annual Charges.

Annual interest, 6 per cent.	\$120,700
Sinking Fund, 1.8 per cent.	36,200
Annual repairs, 2 per cent. on permanent works	28 000
Annual repairs, 5 per cent. on equipment	28 575
Operation	18,000
Administration	20,000
Total	\$251,475

Cost per h.p. per year on basis of 32,000 h.p., \$7.83.

From the above figures it will be seen that according to the White Co.'s estimates, the capital cost per h.p. for the present scheme, namely, permanent works for 36,000 h.p. capacity and initial installed capacity of 18,000 h.p. is \$82. Also, according to the White Co.'s estimates, the capital cost per h.p. for a Hydro-Electric plant of 32,000 capacity would be \$62.50.

While every hydraulic development is a law unto itself as regards capital costs and annual charges, it may be said as a general rule that only under unusually favorable conditions is the capital cost for development brought below \$50 per h.p. For ordinary sites and for average blocks of power \$75 per h.p. is a very reasonable figure, and \$100 per h.p. is well within economic limits.

The power site at Koochiching Falls presents no outstanding features, favorable or otherwise, from the development standpoint, and the capital cost of the plant at present installed might very reasonably be put at \$75 per h.p. When the full capacity of the site is developed the capital cost per h.p. should not fall below \$60, and will probably run about this when the storage works are completed. This being the case, an analysis of actual costs should demonstrate the company's ability to sell power profitably in Fort Frances at \$12 per h.p. per year at the switchboard under present conditions, and this price would become less as the installation approached the ultimate capacity of the site.

It is probable that considerable sums have been expended on promotion, commissions, salaries, engineering and bond flotation, which have been charged to development on the company's books, and would materially increase the cost of power. Whether or not these sums are properly apportioned is a matter requiring investigation. To arrive at the real value of the hydraulic and hydro-electric plant, and subsequently the real cost of power, an examination of the company's books would be necessary. This would appear to be the only definite solution of the question bearing on the cost of power.

As compared with the above estimated cost at Fort Frances it is interesting to note similar costs which are derived from the actual capital cost figures in connection with the Kenora Municipal Plant. These costs are as follows:—

Capital Cost per h.p. at switchboard on basis of 2,700 h.p. capacity at present installed, exclusive of arbitration award	\$133 00
Capital Cost per h.p. at switchboard, on basis of 5,400 h.p. ultimate installed capacity, exclusive of arbitration award	82 00
Capital Cost per h.p. for 2,700 h.p. capacity, based on annual charges for 1909	12 80
Annual Cost per h.p. in future for 2,700 h.p. capacity, allowing additional fixed charges on arbitration award	15 60
Annual Cost per h.p. for 5,400 h.p. ultimate capacity, including fixed charges on arbitration award and charges on additional plant.....	9 65

The above annual costs include operating but no administration charges nor incidental annual repairs, since none of the latter have been necessary during the short period of operation.

Leaving out the capital and annual charges resulting from the arbitration award, the corresponding costs for each scheme, using the White Co.'s estimates, are as follows:—

Capital Cost per h.p. for half capacity:	
Fort Frances	\$82 00
Kenora	133 00
Capital Cost per h.p. for full capacity:	
Fort Frances	62 50
Kenora	82 00
Annual Cost per h.p. for half capacity:	
Fort Frances	9 70
Kenora	12 80
Annual Cost per h.p. for full capacity:	
Fort Frances	7 83
Kenora	9 65

It is evident that the Fort Frances costs are less in every case, which is reasonable because, while other conditions are similar, the average head at Fort Frances is 12 feet greater than that at Kenora.

Present Conditions.

At the present time the sub-structure and super-structure of the Canadian Power House is complete for 9 units. The present installation consists of four, four-runner Holyoke Machine Co. turbines connected to four three phase, 60 cycle, 6,600 volt, 1,250 K.V.A. generators. This plant furnishes energy for street and residential lighting to the towns on both sides of the river, and also supplies power for the motors used for construction machinery. One generator only is operating at present and that under very light load.

The sub-structure and super-structure of the American Power House is complete for 6 units. The installation consists of six four-runner Morgan-Smith

wheels, about 2,000 h.p. rating, each unit being connected to four pulp grinders. A temporary bulk-head has been placed at the shore end of this power house, beyond which is space sufficient to accommodate three more turbine settings and the necessary addition to the power house. None of the wheels in the American Power House are yet in operation. The dam, spillway and sluice construction is complete.

The placing of all the electrical equipment in the Canadian Power House, and all the pulp machinery in the American Power House, gave rise to a feeling of distrust and caused some anxiety as to the Company's motives among the people of Fort Frances. Upon being questioned, the Company's alleged reason for this arrangement, was explained by Mr. E. W. Backus personally, and was substantially as follows:—

It was the original intention of the Company to install fourteen 700 h.p. units in each power house, and the work was begun on this basis and progressed until the summer of 1908. The agitation for Tariff Reform, and the usual period of unrest preceding a presidential election, caused a suspension of the work at that time, as the Company feared an increase in the duty of pulp wood and allied products and the possibility of retaliatory measures by Canada.

During this period of inaction, Mr. Backus conceived the idea which has since materialized; namely, the placing of all the pulp and paper-making machinery required for a 200 ton mill on the American side, and placing the necessary electrical equipment on the Canadian side, thus making the Company's manufactured output independent of the tariff as regards the American market. Mr. Backus obtained the consent of the bond holder's trustee in Chicago, and also alleges that he obtained the permission of the Ontario Minister of Lands and Mines for the installation of the four generators now placed on the Canadian side.

As stated above, there is room to install three more units in the extension of the American Power House, and Mr. Backus states positively *that three electrical units of the same capacity as those at present installed in the Canadian Power House are sufficient to supply all the electric energy necessary for the operation of the ultimate 400 ton mill.* The installation of these three units would, therefore, be more than sufficient to make the industry on the American side entirely independent of the Canadian plant. Also, two of the electrical units at present installed on the Canadian side would be ample to supply the requirements of a 200 ton mill, so that the output of the other two units will be available for general power purposes.

Export of Power.

The rights of the Province in this connection appear to be safeguarded by the Dominion Act of 1905, and the Ontario Act of 1906, and it is simply a question of enforcement.

In the matter of prohibiting the export of power it may be mentioned that the Company has not complied with Clause 2 of the Dominion and Clause 1 of the Ontario Act, which calls for concurrent development on both sides of the river, so that at no time will there be more power available for use on the American side than on the Canadian side. At present the installed turbine capacity on the American side exceeds that on the Canadian side by 4,000 h.p. Clause 1 of the Ontario Act provides that this measure may be modified at the discretion of the Lieutenant Governor in Council, but there is no evidence that such formal consent has been obtained. This evasion of the Acts might call for corrective measures. Also, if any large amount of power were exported, the industry or industries which

it supported might be very seriously influenced when the time came to use the power on the Canadian side, so that it would appear more reasonable to establish these industries on the Canadian side at the outset. This may be put in the form of a general statement that Canadian power should not be exported to build up American industries at the expense of Canadian industries.

If the responsibility of promoting the industrial activity of the Town of Fort Frances is to be borne by the Minnesota and Ontario Power Co., the proper course would be to prohibit the export of power, if the Acts allow it, and at the same time rigidly enforce the other conditions set forth in the Dominion and Ontario Acts.

On the other hand, if the Town of Fort Frances is to be made responsible for its own industrial welfare with no direct assistance from the Company, the Government could allow the temporary export of power under certain conditions. The prime condition would be the setting of a definite price for power which the Town could advertise as an inducement for the establishing of industries. The second condition would be to set a limit to the amount of power to be temporarily exported. Under present conditions the amount should be limited to 6,000 h.p. for a reason presently to be stated. The third condition should provide that the work in connection with the development of the storage system be proceeded with at once and completed. Also various conditions of a legal nature should be imposed to make the main conditions binding and operative.

Storage.

As previously stated, the present scheme of development calls for 18,000 h.p. installed turbine capacity in each power house, making 36,000 h.p. installed in all.

Under present normal conditions there is sufficient water in the Rainy River to develop 36,000 h.p. at Koochiching Falls, but at low water periods the capacity of site drops to less than 15,000 h.p. It is evident, therefore, that with 18,000 h.p. installed, enough water could be drawn through the wheels in the American plant to completely shut down the Canadian plant, during the period of minimum flow. Then even though no electric power were being exported, all the Canadian water would be diverted to the American side, which would be the same in effect, as it would practically mean the export of hydraulic power instead of electrical.

It is estimated that the projected storage works will equalize the flow to such an extent as to provide 36,000 h.p. continuously. This being the case it would be possible for the American plant to develop full rating without causing the diversion of Canadian water. As the wheels at present installed in the American plant can at times, under present conditions, divert practically all the Canadian water, it is evident that the Company should be required to complete the storage works, in any case before any more hydraulic machinery is installed on the American side.

Conclusion.

In view of the various facts above stated, it would appear that two causes of action are open; first, to prohibit the export of power altogether and thus throw on the Company the responsibility of building up industries on the Canadian side, these industries either to be controlled by themselves or to be simply independent power customers. The second course would be to allow the export of power on condition that a price be set at which the power can be sold on the Canadian side up to the capacity of the Canadian plant, and that the storage works be completed forthwith, and that not more than 6,000 h.p. be exported. The limit is set at 6,000 h.p. because this is the amount of reserved capacity in the American plant. In the event of all or any part of this power being required on the Canadian side, the

Company can, upon sufficient notice, install such portion of the reserve as will compensate for the power reclaimed for use on the Canadian side.

It may be said in conclusion that whatever course is adopted, steps should be taken to determine a fair selling price for the Canadian power, as the people of Fort Frances feel that there is urgent need for independent action on their part in matters relating to the promotion of industry.

March 23rd, 1911.

REPORT NO. 2.

Fort Frances.

Pursuant to verbal instructions, we investigated the question of the cost of power as developed by the Minnesota and Ontario Power Company, at Fort Frances, and made the necessary examinations of the plant to determine its cost and the amount of power available.

We were advised that we would receive the necessary information from the Company to enable us to determine their actual capital expenditure. Although we applied for it repeatedly, this information was not supplied, and we were forced to adopt other means to ascertain these figures.

In addition to the information secured regarding the physical equipment, our Engineers determined at the time of their visit the amount of water passing down the river.

With this information in hand we are able to report as instructed, notwithstanding our failure to obtain directly from the Company the information promised.

We also familiarized ourselves thoroughly with the history of the Company, its relation to Canadian interests, and the power granted both by the Ontario and Dominion Governments, so that the whole question has been studied in all its aspects, from its inception to the present.

Available Water.

Complete records of the hydraulic conditions of the Rainy River do not exist. Various measurements of the river flow have been made at different times however, which yield a certain amount of information.

On September 27th, 1910, we measured the flow of the river and found it to be 5,229 second feet, and although this measurement appears to show the minimum flow of the river, it is very probable that in the month of February the flow would be less.

The drainage area consists of about 14,500 square miles of which about 10,500 square miles are in Canadian territory. A large proportion of lake area is included in this drainage basin. About 370 and possibly 400 square miles of this lake area can be used for direct storage purposes above the present power development. This water level may be raised at least five or six feet, and a large quantity of water stored and employed to equalize the flow, increasing the minimum flow very materially.

It is impossible to store and utilize all of the water that reaches the Lakes, and as a result a considerable quantity will necessarily waste itself each spring.

The Rainy River is also being used for lumbering and a log slide which would require a considerable quantity of water for its operation would necessarily have to be built.

After carefully considering the drainage area and the river discharge, from the information at hand we have come to the conclusion that the dependable flow cannot be considered greater than 10,500 second feet. The working head when the works are completed may be assumed as 30 feet, but this figure may vary two or three feet either way.

We, therefore, consider that the potentiality of the river does not warrant the installation of more than 28,000 water wheel horse-power.

During future years of operation of the plant, it may be found that the dependable power will be greater or less than the figures just given, but we believe

that for present consideration, and as a definite working basis, these figures are fair, and with our present knowledge of the river it would be unwise to make other assumptions.

The Rainy River is an International Boundary River, and the interests of the two countries are, therefore, equal. This was apparently recognized when the plans were prepared for the power development. The dam and regulating gates are common to the power houses, and the power houses on each side of the river are practically identical in their general lay-out, that is, they are laid out to eventually contain nine power units.

We might draw your attention to the fact that the power units installed on the American side have a greater unit capacity than those installed on the Canadian side, and that at present there are six units installed on the American side and only four on the Canadian side, and if the remaining spaces are supplied with power units of the same capacity as those already installed, the power capacity of the American power house will be 30 per cent. greater than the capacity of the Canadian plant when fully completed with units of the capacity now installed there. This fact, alone, would indicate that the Company has departed from the equal division of power principle between the two countries.

The general plan of the development you are already familiar with, and all that we can say, as a result of our inspection, is that the work has been constructed in a substantial manner.

At present the installations consist of the following:—

In the American power house six units of 2,200 water wheel horse-power are at present installed and direct connected to wood pulp grinders. There is available space for three more similar units.

On the Canadian side four units of about 1,700 wheel horse-power have been installed and coupled to electrical generators of 1,250 kw. capacity each. There is sufficient room remaining for five additional units.

With the exception of about 130 kw. the whole of the present electrical output of the Canadian power house is transmitted to the American side of the river.

Capital and Operating Costs.

The capital and operating costs have been determined and arranged under the four following heads:—

(1) The Capital and Operating Costs of the total present Canadian and American Hydraulic Plants, up to the wheel coupling:

Cash Cost	\$1,132,015 00
Capital Cost (bonds sold at 80)	1,415,018 00
Operating Costs and Fixed Charges	121,556 00
Cost per h.p., year, based on 20,300 h.p. output	5 98

(2) The Capital and Operating Costs of the Canadian Electrical Equipment as at present installed:

Cash Cost	\$101,000 00
Capital Cost (bonds sold at 80)	126,250 00
Operating Costs and Fixed Charges	19,975 00
Cost per h.p., year, based on 6,400 h.p. output	3 12

(3) The Capital and Operating Costs of the probable full commercial hydraulic development, Canadian and American, up to the wheel coupling:

Cash Cost	\$1,249,598 00
Capital Cost (bonds sold at 80)	1,562,000 00
Operating Costs and Fixed Charges	140,143 00
Cost per h.p., year, based on 28,000 h.p. output	5 00

(4) The Capital and Operating Cost of sufficient Electrical Equipment in the Canadian Plant to utilize one-half of the commercial potentiality of the whole river:

Cash Cost	\$222,200 00
Capital Cost (bonds sold at 80)	277,750 00
Operating and Fixed Charges	40,065 00
Cost per h.p., year, based on 13,150 h.p. output	3 05

Yearly Cost of Power.

From these figures the costs per horse-power year under various conditions are as follows:—

(1) Hydraulic Power at the wheel couplings under present conditions..	\$6 00
(2) Hydraulic Power at the wheel couplings, under full development conditions	5 00
(3) Electrical Energy at the Canadian switchboard, present conditions.	9 10
(4) Electrical Energy at the Canadian switchboard, under full development conditions	8 05

November 11th, 1910.

REPORT NO. 3.

Thessalon.

Acting under instructions, the Commission's Hydraulic Engineer visited Thessalon on March 19th and 20th, and succeeded in convincing the Mayor and Council that commercial development for general power purposes was impossible either on the Thessalon River or at the Basswood Lake location mentioned in the Clerk's letter. The watershed in both cases is of such a restricted nature that no adequate water supply can be obtained. They are now satisfied that the Mississagi River is the only commercial source of power supply available to Thessalon and Bruce Mines. The Fifth Report of the Commission includes an estimate of the cost of supplying Thessalon and the Bruce Mines from this development at Slate Falls on the Mississagi. Two years ago an estimate was also made for Bruce Mines on the cost of transmitting power from Squaw Chute to that town, so that the power recommendations of that neighborhood have been pretty well investigated. Probably the only possibility of Thessalon being able to finance a development proposition on the Mississagi is through their co-operation with Bruce Mines, and they have been advised to this effect.

They were also advised to obtain from the Crown Lands Department information as to whether or not the site at Slate Falls is free from incumbrances. The site is said to be held at present by parties in the United States, who have a mining location there, but whether they have a patent or whether the lease is subject to cancellation is a matter of investigation.

March 22nd, 1910.

REPORT NO. 4.**Mississippi River.**

The plans and specifications for storage dams at Gull and Long Lakes in the watershed of the Mississippi River have been examined, and we have no serious criticism to make. The overfall sections are amply strong and the double checks in the sluice piers add greatly to the security and operating convenience of the stop log portion of the dams. If these dams are built according to the plans and specifications there is every assurance that they will be safe and permanent structures. It would be well, however, for the Commission to supervise to a certain extent their construction, especially in the early stages, in order to be assured that the foundations are properly stripped and the bed-rock contact satisfactory. It might also be advisable to secure some discharge measurements in the vicinity of the dams.

As regards the general lay-out of the scheme as shown by the plan, it would seem that both dams are deficient in the sluice-way discharge area. At low stages when the water drops below the crest of the overfall the available discharge area will be comparatively small and will allow very little water, over and above natural discharge, to be drawn off the lakes below their natural minimum level.

However, in this particular instance, the above defect is not serious for two reasons; first, because the principal function of these dams is to store flood-water in order to shorten the low water season, and close regulation of flow is not of first importance; and second, because the principal point of regulation is located at the Cross Lake Dam, and any irregularity of discharge from Long and Gull Lakes can be compensated for in the sluices at Cross Lake.

It is highly important that the contract be placed at once in order that the construction may be advanced as far as possible before the freezing weather.

September 19th, 1910.

REPORT NO. 5.**Mississippi River.**

On October 12th and 13th the Hydraulic Engineer visited the dam sites at Gull and Long Lakes in the Mississippi watershed, the object of the trip being to make an inspection of the sites and to determine whether or not they were suitable, topographically and physically, for safe and economical construction.

The Contractor had already commenced work at Long Lake and had the site unwatered and stripped sufficiently to show that there was no cause for anxiety as to the material upon which the dam was to be built, as it was solid rock throughout, with the exception of some weathered portions on each shore, where several fissures and frost-cracks are to be shot out or plugged with concrete before the actual construction of the dam is commenced. Practically the same conditions exist at Gull Lake.

The cement is being hauled to the sites of the dams and placed in well-built weatherproof sheds. Fairly good sand and gravel are available within easy teaming distance at both sites. The contract is not a large one, and only requires reasonable care during construction and adequate measures for protection from frost to make the work safe and permanent.

The work covered by the present contract is only preliminary to the full development of the Mississippi, and the Cross Lake storage will probably be the next in order for development.

October 25th, 1910.

REPORT NO. 6.

Renfrew.

The Hydraulic Engineer of the Commission visited Renfrew during the early part of the present month to investigate local power conditions; also to determine the extent of the storage possibilities of the Bonnechere watershed, to recommend a scheme of development. Owing principally to the dry spring, the water in the Bonnechere at this time had reached a low stage unprecedented in the history of the river, and had failed almost entirely as a source of power. An idea of the conditions in the town of Renfrew may be obtained from the following list of electric and hydraulic energy users:

M. J. O'Brien	50 h.p.	motor shut down.
Hilliard Brick Yard	50	" "
Renfrew Brick and Tile Company	65	" "
Renfrew Street Lights		" "
Scott & Jamieson	10	" "
Renfrew Manufacturing Company	35	" ¼ time.
Renfrew Machine Company	35	" ½ time.
Renfrew Roller Mills	115	" 4 hrs. per day.
Renfrew Water Works	50	" using steam.
Renfrew Lime and Quarry		" "
Renfrew Milling Company, Hydraulic		" "
Renfrew Knitting Company		" "
Renfrew Electric Company		" "
Logan Bros.		" "
Imbleau Foundry Company	6 h.p.	motor "

It is evident from the above data that low water in the Bonnechere means a very serious financial loss to the Municipality of Renfrew, as well as other power-users along the river, and it is therefore necessary that some action be taken to alleviate present conditions. The preliminary investigation of storage possibilities in the watershed was undertaken with this object in view.

There are in the Bonnechere watershed a considerable number of Lakes, the most important being Golden Lake, Round Lake, Clear Lake, Paugh Lake, and Rabbitail Lake.

Of these, Golden Lake and Round Lake, having a combined area of about 26 square miles, are the most important as regards available storage capacity and volume of run-off. The available sites for dams at the outlets are none too good from a topographical standpoint, but in view of the large volume of storage, the unit cost of storage will be very reasonable indeed, probably less than fifty cents per acre foot.

The best dam location at the foot of Golden Lake is immediately below the bridge of the Pembroke branch of the Grand Trunk, and is about half a mile from the village of Golden Lake, so that convenient arrangements can be made for attendance. The bed of the stream is covered with boulders, but both banks are overlaid with soil, so that it will be necessary to dig test pits to determine the nature of the under-lying material. The site of this dam is only a quarter of a mile from Golden Lake Station on the Grand Trunk, and first-class sand is available within a mile.

At Round Lake the conditions at the best dam location are more favorable than at Golden Lake, as there is an outcrop of solid rock on each bank. First-class sand is available within a mile, and the teaming distance from Killaloe, on

the Grand Trunk, is about six miles by a good road. Arrangements for attendance on the dam could be made with a farmer, whose house is immediately adjacent to the site.

The amount of water that can be stored in these two lakes cannot be determined definitely until a survey has been made and flood contours established. The Bonnechere watershed is composed almost entirely of surveyed and sub-divided townships, and about the shores of Golden and Round Lakes a considerable number of cleared farms are located, many being occupied at the present time. These will be more or less effected by the building of storage dams, and one object accomplished by the survey will be to determine the extent of damage due to raising the water to different levels.

Assuming three feet and five feet of storage available on Golden and Round Lakes respectively, a rough calculation based on available data indicates that the



" Timber Slide," Chats Falls, Ottawa River.

storage run-off would maintain a continuous discharge of 250-second-feet for about 125 days. This discharge would produce 840 h.p. at the turbine shaft in the Renfrew Power Company's plant and at the Municipal Power Site. Also the surplus run-off would be sufficient to provide an average continuous discharge of 870 second-feet for the remaining 240 days. As this surplus run-off is non-regulated, it is possible that the minimum discharge might at times fall below 250 second-feet, but this condition, if it exists, can be modified and possibly eliminated by either impounding more water in Golden and Round Lakes or developing other storage basins in the watershed.

The greater portion of the Bonnechere watershed has been timbered with pine and is now fairly well covered with second-growth pine and hard wood. It is very sparsely settled as the land for the most part is quite unfit for agricultural purposes. It is probable that all the larger lakes in the watershed may be in the future developed to the limit of their capacity for storage purposes, and in view

REPORT NO. 7.**Renfrew.**

The level of the Bonnechere reached such a low stage in the fall of 1910, that the river was practically useless as a source of power, and for some time such industries in the Town as were not equipped with steam auxiliaries were practically without motive power. The details of the situation were set forth in the Chief Engineer's Report to the Chairman of the Commission under date October 25th, 1910.

The conditions at that time demonstrated conclusively the necessity of providing adequate means of improving the flow characteristics of the river, and during the past winter the watershed was examined and certain surveys made to ascertain the extent to which conditions could be improved by artificial storage. The object of this report is to set forth the results of the work so far accomplished and to draw such conclusions as the data collected would warrant.

Precipitation and Run-Off.

Due to the lack of rainfall records in the Bonnechere watershed, it is impossible to estimate the percentage of run-off with certainty. Records at Renfrew extending back to 1882 indicate that the mean annual rainfall at that point is about 25 inches. Records for any other points in the watershed are entirely lacking, but on the height of land in the Algonquin Park region the records show a mean annual rainfall of 40 to 43 inches. In view of this it would seem reasonable to assume 30 inches as a measure of the average distribution of rainfall above Golden Lake Village and 25 inches for the mean annual rainfall on the remainder of the Bonnechere watershed.

The measured run-off of the Ottawa basin averages about 52 per cent. of the annual precipitation, and the run-off of the Beaver River for the year 1910 is about 45 per cent. of the mean annual precipitation. Up to the present time, these are the only two rivers in the Province for which the approximate run-off has been estimated. It will probably be safe, however, to assume that the Bonnechere can deliver $33\frac{1}{3}$ per cent of the annual rainfall, and on this basis the upper basin would deliver 10 inches, and the lower basin 8.33 inches of rainfall, using the figures for mean annual precipitation just assumed. All subsequent figures will, therefore, be based on 30 inches and 25 inches of mean annual rainfall, and 10 inches and 8.33 inches of run-off, respectively.

Character and Extent of Watershed.

The watershed of the Bonnechere above Renfrew has an area of about 833 square miles, the head waters being within the limits of Algonquin Park.

The watershed contains a considerable number of lakes, the most important being, in order of magnitude, Golden Lake, Round Lake, Clear Lake, Paugh Lake and Rabitaille Lake. Below the Township of Richards the rock formation is overlaid with sand and sandy loam with an occasional outcrop, and the country is cleared and settled. Above the Township of Richards the rock outcrop predominates and the country is wild and unsettled. Golden, Round and Clear Lakes are in the settled district, and Paugh and Rabitaille Lakes are in the upper and unsettled portion of the watershed, which at one time was covered with white pine. The pine has been cut out or burned out and the district is becoming reforested with hard-wood and a considerable quantity of second growth red and white pine. As the reforestation continues, the ground storage capacity of the watershed will increase and the natural regulation of flow will be improved.

Storage Capacity and Run-Off.

The extent of the storage possibilities in the Bonnechere watershed will be considered to be covered by the five lakes listed above, and in tabular form hereunder is given the lake area, area of catchment basin, available run-off, storage draft and storage capacity. The storage draft on Golden and Round Lakes has been determined by inspection and survey, but for the other three lakes it has been estimated only, the estimates being considered reasonable.

Lake.	Catchment Basin Sq. miles	Lake area Sq. miles	Storage draft feet	Run-off Millions of cub. feet	Storage capacity Millions of cub. feet
Golden	560	14.6	3	13,005	1,221
Round	403	10.8	6	9,359	1,808
Paugh	31	2.7	10	720	453
Rabitaile....	13	.55	15	302	280
Clear	41	6.8	5	791	948

From these figures it would seem that the estimated storage draft on Paugh and Clear Lakes should provide storage capacity more than sufficient to conserve the entire run-off of their respective watersheds, while in the case of Round and Golden Lakes there would be a large surplus run-off after their storage capacity had been exhausted.

The watershed of the Bonnechere above Golden Lake will deliver 13,005 millions of cubic feet per annum on a basis of 10 inches of available precipitation, and the remainder of the watershed above Renfrew, about 273 sq. miles, will deliver about 5,267 millions of cubic feet per annum on a basis of 8.33 inches of available precipitation. The total annual discharge at Renfrew would, therefore, be 18,272 millions of cubic feet. The total storage capacity as calculated above is 4,821 millions of cubic feet, or about 26 per cent. of the annual run-off. Taking into account the possibility of fall replenishment, the complete reservoir system should be able to control 40 per cent. of the annual run-off.

Scheme of Development.

While the full development of the storage facilities of the Bonnechere watershed will no doubt ultimately be found necessary, it would be unwise and hazardous to proceed with the full development at once with such meagre data available in connection with rain-fall and run-off. A safer course to pursue would be to let a reasonable period of time elapse between the successive stages of development, in order that sufficient data could be collected to prove the truth or fallacy of the assumptions upon which the scheme is at present based. Following out this line of reasoning, the first step would be the construction of a storage dam at Round Lake. This lake has the greatest storage capacity and the topographical features of the dam-site are favorable for construction, so that the development of its storage would afford a maximum amount of relief with a minimum of capital investment.

The next step in the development should be the building of a dam at Golden Lake. Topographical conditions are not favorable for the building of a dam at Golden Lake, but the volume of storage is large enough to warrant considerable capital investment when additional storage is required. Subsequently, Clear Lake, Paugh Lake, and Rabitaile Lake could be developed in the order named, and thereafter the control of Round, Rabitaile and Paugh Lakes could be centralized at the Golden Lake dam, and water being drawn off the upper lakes intermittently

as the level of Golden Lake was drawn down. The water impounded in Clear Lake could be held as a reserve to tide over periods of extreme maximum flow.

Estimated Volume of Storage Flow.

The estimated mean annual run-off of the Bonnechere watershed above Renfrew would produce an average continuous discharge of 580 second-feet throughout the year with perfect regulation. Assuming that the mean discharge in a dry year would be 75 per cent. of this, the minimum mean discharge would be 435 second-feet.

The mean discharge of the Ottawa River is equivalent to 1 cubic foot per second per square mile of watershed, and 435 second-feet is equivalent to only .52 cubic feet per second. Assuming as above that the completely developed system can control 40 per cent of the annual run-off, 300 to 350 second-feet should be considered a conservative estimate of ultimate minimum flow at Renfrew.

Considering the Round Lake storage by itself, a dam with 6 foot draft on the sills could deliver 175 second-feet for 120 days from storage alone. This would mean a minimum of 225 second-feet at Renfrew, if the extreme low-water discharge at that point is assumed to be not greater than 50 second-feet. The uncontrolled surplus run-off of 16,464 million cubic feet could probably be depended upon to hold this minimum for the remaining 8 months of the year.

The joint effect of the Round and Golden Lake storage would be to produce a continuous discharge of 250 second-feet for 140 days, leaving an uncontrolled surplus of 15,242 million cubic feet to hold this minimum for the remaining 225 days of the year.

The combined storage of Round, Golden and Paugh Lakes, would produce a continuous discharge of 250 second-feet for 174 days, leaving an uncontrolled surplus of 14,523 million cubic feet to hold this minimum for the remaining 191 days of the year.

The combined storage of Round, Golden, Paugh and Rabbitail Lakes would produce a continuous discharge of 300 second-feet for 151 days, leaving an uncontrolled surplus of 14,371 million cubic feet to hold this minimum for the remaining 214 days of the year.

The Clear Lake storage would produce a continuous flow of 102 second-feet for 90 days. As before mentioned the Clear Lake water could be held to tide over periods of extreme minimum flow, or to help out the uncontrolled discharge if it should prove at times unable to adequately supplement the discharge from storage.

It is to be noted that the discharges above estimated are based upon the assumption that the reservoirs will be filled only during the spring freshet. It is reasonable to expect some replenishment in the autumn, in which case the figures given above should be exceeded. All these figures at the present time, however, simply indicate reasonable possibilities, and whether or not they will be fully realized can only be ascertained through experience in operation.

Power Capacity.

The figures hereunder show the amounts of continuous 24 hour power available at the turbine shaft at Renfrew under a 35 foot head, using the figures for discharge as above:

Discharge.	Horse-Power at 35 ft. head.
300 second-feet	955 h.p.
250 "	795 "
225 "	715 "
175 "	557 "

As the above figures refer to continuous 24 hour power, the plant at Renfrew could install capacity for a mixed load of 10 hr., and 24 hr. power anywhere up to 50 per cent. in excess of the power capacities tabulated above, the amount of such excess depending on the relative proportions of 10 hr. and 24 hr. power, and upon the facilities for regulating daily flow.

Costs.

The work done last winter included a contour survey of Round Lake, a detailed survey of the dam-site and an investigation of the dam-site at Golden Lake. From the data collected it has been possible to prepare a fair estimate of the cost of storage works at Round Lake, a favorable location for the dam having been established.

The dam location at Golden Lake is not good, quicksand being encountered in the test-pits, but the volume of storage would justify considerable expenditure for construction at this point.

No effort has been made as yet to establish the location of dams at Clear, Paugh and Rabitaille Lakes, but it is reported that favorable sites are obtainable. It will also be necessary to make contour surveys of Golden and Clear Lakes before any costs, other than those in connection with Round Lake, can be determined.

The plan of Round Lake submitted herewith shows that by raising the water 6 feet above winter level, about 371 acres of land will be flooded, and by raising it 10 feet above winter level, about 682 acres of land will be flooded. The storage capacity of the lake has been estimated for the 6 foot rise only. Assuming \$10.00 per acre as an average price, it would cost about \$3,710 to purchase the necessary flood privileges. A careful estimate of cost indicates that a dam with three 14 foot sluices, a long-chute and a 100 foot spill-way, capable of holding 8 feet of water on the sills, could be built at low water for \$3,700. The total cost of land damages and construction as estimated above would, therefore, be \$7,410 or about 18c. per acre-foot of storage. This very low unit cost demonstrates the economic advantage of the scheme beyond possibility of argument.

It should be noted that the departmental survey calls for a 66 foot road allowance about the shores of Round Lake and on both banks of the Bonnechere River in the Township of Hagarty and Richards. The original survey of Round Lake was made in January to March, so that the shore contour of the lake and river at that time would be similar to that established by last Winter's survey and should have about the same length, namely, 20.4 miles. On this basis the total area of road allowance within the flood limits would be 163 acres. This would reduce the flooded area on private property to about 208 acres. All patents granted for lots in this district reserve the chain allowance on the water-front, and if advantage were taken of this, a considerable number of claims might be eliminated entirely.

July 4th, 1911.

REPORT NO. 8.

Simcoe Railway and Power Company.

Plant located at the Big Chute on the Severn River.

Present operating head—56 feet.

Ultimate minimum capacity installed—5,000 h.p.

Present capacity installed—3,000 h.p.

Transmission Distances:

To Midland	28 miles.
To Penetanguishene	33 miles.
To Barrie	52 miles.

Permanent Works:

- Concrete power house.
- Concrete head-works.
- Concrete waste-way.
- Concrete main dam with stop-log sluices.
- Concrete canal retaining-walls.

Hydraulic Equipment: (present installation)

- 1 Steel penstock 9 ft. inside diam.
- 1 Surge tank 10 ft. inside diam.
- 2 Main unit feeder-pipe, 5 ft. 6 ins. diam.
- 1 Main unit feeder-pipe, 5 ft. 6 ins. diam.
- Exciter feeder-pipe, 3 ft. 8 ins. diam.
- 3 Vertical, single seated, 66 ins. gate valves on main unit feeder-pipes.
- 3 Vertical 30 ins. gate valves on exciter feeder-pipes.
- 3 Leffell double turbines, 35 ins. runners horizontal setting, steel wheel-case and central discharge draft-tubes.
- Max. capacity—1,300 h.p. at 300 r.p.m.
- Efficiency at 70 to 85 per cent. gate, 80 per cent. guaranteed.
- Efficiency at 60 per cent. gate, 75 per cent. guaranteed.
- Lombard governors installed with each unit:
- One unit to be held as a spare.
- 2 Exciter turbines, 56 ft. operating head, single runner, 17 ins. diam. Capacity—200 h.p. at 580 r.p.m.
- Lombard governors installed with each unit:
- All hydraulic equipment built and installed by the Wm. Hamilton Co., of Peterboro.

Electrical Equipment: (Power House.)

- 3-900 kv-a. Generators (720 kw. at 80 per cent. power factor) water wheel type, 60 cycle, three phase, 2,200 volts, 300 r.p.m. One unit to be held as a spare.
- 2 Exciter Generators, direct current, 125 volts, 100 kw. 580 r.p.m.
- 3 Transformers, 600 kv-a. capacity, three phase, 60 cycles.
- Low tension taps 2,200, 2,100, 2,000, 1,900 volts.
- High tension taps, 25,000, 24,000, 23,000, 22,000 volts.
- Oil insulated, water-cooled.
- No spare unit installed.
- Transformers connected delta to delta.

Switchboard :

3 generator panels, 1 transformer panel, 1 line panel, 2 exciter panels, 1 local service panel, 1 station instrument panel. Switchboard installed with all necessary instruments.

Lightning Protection :

One set type "A" lightning arrestors, style No. 120834, 22,000/25,000 volts. Ungrounded neutral, with combination disconnecting switch, and horn gap fuses, oil and electrolyte.

All electrical equipment installed by Washington Electric Company of Hamilton.

Transmission Line :

Poles—cedar: standard length, 35 ft., 100 foot spacing.

Insulators—33,000 volt porcelain, supplied by the Pittsburgh High Tension Insulator Co. Mounted on wooden pins.

Cable—No. 00 B. & S. aluminum, supplied by the Northern Aluminum Company.

Construction—One three-phase circuit only erected. Two lower wires mounted on two-pin arms. Upper wire mounted on top-pin with peak casting. No ground wire installed. Storm-guys placed every tenth pole and side guyed every tenth pole on tangents. Corner poles buck-armed. Three special steel towers erected at water crossing near Waubaushene for copper conductors on 1,100 foot maximum span. Right-of-way cleared for sufficient distance each side of line to prevent damage by wind-falls. Telephone line mounted on same poles.

Sub-Station :

Building—red brick, gravel roof.

Equipment—3-550 kv-a. transformers, three-phase, 60 cycles.

High tension taps 22,000, 21,000, 20,000, 19,000 volts.

Low tension taps 2,300, 2,200, 2,100, 2,000 volts.

Oil insulated, water-cooled.

No spare unit installed.

Transformers connected delta to delta.

Switchboard—1 line panel, 1 transformer panel, 5 feeder panels, 1 station panel.

Switchboard installed with all necessary instruments.

Lightning protection.—One set type "A" lightning arresters, style No. 120834, 22,000/25,000 volts. Ungrounded neutral, with combination disconnecting switch and horn-gap fuses, oil and electrolyte.

Guaranteed Electrical Efficiencies.

<i>Generators:</i> At 1¼ load, 94.4% minimum, 100% power factor							
"	full	"	94.1%	"	"	"	"
"	¾	"	92.8%	"	"	"	"
"	½	"	90.0%	"	"	"	"
"	¼	"	84.25%	"	"	"	"

				600 kv-a.	500 kv-a.
<i>Transformers:</i>	At	¼ load	..	96.4%	96.4%
	"	½	"	97.9%	97.7%
	"	¾	"	98.2%	98.1%
	"	full	"	98.3%	98.2%
	"	1¼	"	98.2%	98.1%

Present Stage of Construction.

At the time of inspection all dam construction had been completed, also the head water canal, inlet piers and racks. The power-house walls and roof were completed and the temporary wooden end was being built. The remainder of the work to be done in the power-house consists mainly of the placing of floor-slabs and glazing.

The penstock, feeder pipes and wheel cases were on the ground and installation of same was in progress. The surge tank was nearly completed. The main turbines and exciter units and governors were not delivered, but were believed to be in transit. Considerable difficulty is being experienced in connection with the transport and erection of the hydraulic equipment, resulting from its being shipped in heavy and unwieldy sections.

The electrical equipment is practically all on the ground, and will shortly be installed.

All poles have now been erected on the transmission line, and all material has been delivered. Cable is being erected at the present time, as well as the guying and the bracing, which is done at the same time. The steel towers have been delivered at Waubashene, and they are probably being erected at the present time.

The sub-station building at Midland has been completed and is ready for the installation of electrical equipment.

The Company will probably not be in shape to deliver power before the first of April.

The building and permanent works of the Company are fairly well designed, and the workmanship and quality of material are excellent. The hydraulic and electrical equipment at the generating and receiving end is of standard type, but the reliability of the service would be increased by the installation of a spare transformer at each end of the line.

The transmission line, consisting as it does of a single circuit with the upper wire on top of the pole and no ground wire, is the weakest link in the system. The line is built, however, in a substantial manner. The poles are strong, closely spaced and securely guyed, and the insulators have a good factor of safety. The line is, therefore, in good condition to withstand wind and sleet, the latter being very seldom encountered in that region. The main cause of interrupted service would probably be malicious injury or the shattering of insulators by lightning. It is reported that the single circuit line from the Ragged Rapids to Orillia has given practically no trouble since the plant was installed, and the same conditions might reasonably be expected to exist in the case of the line from the Big Chute.

The municipalities of Midland and Penetang both have steam pumping plants installed, and as far as the municipal needs are concerned, interrupted service could merely cause annoyance and inconvenience. It is a different matter, however, with industrial load, and while in the beginning the operation of the system may prove entirely satisfactory, the lack of line duplication and spare transformer equipment is a possible source of trouble which will undoubtedly manifest itself sooner or later.

December 9th, 1910.

REPORT NO. 9.**Lindsay Light and Power Company.**

Attached hereto is a detailed report on the plant of the Light, Heat & Power Company of Lindsay, Ont., and also a report, with estimates, dealing with the proposal of the municipality of Lindsay to purchase the Company's plant.

The Company's generating plant is located at Fenelon Falls, and power is transmitted at 11,000 volts to the substation at Lindsay.

The distribution of the power sold and the resulting revenue from different classes of service show that the lighting service, while it produces 66 per cent. of the total revenue, uses only 24 per cent. of the total output of power, and the industrial load, while it produces only 34 per cent. of the total revenue, consumes 76 per cent. of the total output of power. This would indicate that any revision of rates should tend towards a reduction of unit rates for incandescent lighting, the present net rates being 9 3-8 cents for residential and a special rate of 8 cents for certain classes of commercial lighting.

The kilowatt hours sold under the general rates for lighting during 1910 amounted to 140,049, while the kilowatt hours sold under the special lighting rate amounted to 54,730. The total quantity of power sold for all classes of lighting was 456,000 kilowatt hours, as compared with 1,464,000 kilowatt hours sold for power.

Power Conditions.

The maximum instantaneous load at the switchboard of the plant at Fenelon Falls during 1910 was approximately 910 h.p., and the average annual load about 355 h.p., which gives a load factor of approximately 39 per cent.

These figures were derived from the station load sheets, but since there were no watt-hour meters or power-factor meters installed, it was necessary to assume an arbitrary value for power factor, which necessarily makes the above figures approximate. They are sufficiently accurate, however, to demonstrate the necessity of improving the load-factor if the municipality were purchasing power under a contract similar to those made by the municipalities in the Niagara System. This can best be done by increasing the industrial load and at the same time encouraging customers to enter into limited hour contracts.

Distribution and Sale of Power by Municipality.

In the event of the Town of Lindsay definitely deciding to acquire control of the local power situation, three alternative courses of procedure seem to be worth considering: first, to purchase outright the low-tension distribution system and contract with the Commission or with the Company for the supply of power delivered at the low tension busbars in the Lindsay sub-station, second to purchase outright the transmission line and low tension distribution system, and contract with the Commission or the Company for a supply of power delivered at the high tension busbars at Fenelon Falls; third, to purchase outright the entire property of the Lindsay Light, Heat and Power Company, including water-rights, generating plant, transmission line and distribution system.

In the first case, the price paid to the Company would include a profit on generation, step-up transformation and transmission. In the second case, the price paid to the Company would include a profit on generation and step-up transformation only. This advantage is to a certain extent offset by the fact that the

transmission line is not by any means a first-class piece of construction and the depreciation and maintenance charges would be high, so that the second alternative would have no advantage over the first unless the transmission line could be acquired strictly on the basis of its present physical worth. There is no reasonable hope of doing this, as the line is at present an integral part of a very profitable concern.

Under the third alternative, the Municipality would have complete control of the system from the point of generation to the customers' service connections. This would place all matters relating to the cost of power entirely under the control of the Municipality, and also relieve them of contract restrictions which might prove onerous if the municipal market retained its present characteristics.

Under the first two schemes a low-load factor would have the effect of penalizing the generating company, and compensation would have to be provided for in



"The Horse-Shoe," Chats Falls, Ottawa River.

the cost of power and in the terms and conditions of the contract. If the Municipality owned the generating plant, however, the effect of a low-load factor would be shifted back one stage to the water supply, which would entail no penalty and consequently no pecuniary compensation or contract restriction.

Another important point to consider is that in owning the transmission line and distribution system, the Municipality will have on its hands a constantly depreciating asset which will require the expenditure of considerable sums annually for maintenance, as well as a yearly sinking-fund appropriation to maintain the system at its present value. If the generating plant is purchased, the Municipality will have in the power-site and water-rights an appreciating asset, the increasing value of which will go a long way towards balancing the depreciation on other portions of the system.

The appreciation in value of the power-site is due to two causes; first, because the constantly increasing cost of fuel generated power tends to make all hydraulic power-sites relatively more valuable; secondly, because the storage works in the Trent River watershed are being constantly enlarged and improved, and the resulting increase in low-water flow is becoming more and more apparent. As a result, the water-powers on the Trent Valley Canal System, of which that at Fenelon Falls is one, are increasing in value year by year, and the best obtainable regulation of flow has not yet been realized.

In view of these facts it should require no further argument to prove that the best plan for the Municipality to follow is to acquire the entire plant and rights of the Lindsay, Light, Heat and Power Company, and to consider the other two alternatives only on condition that unsurmountable difficulties arise in carrying on the negotiations for complete purchase.

Power Capacity.

Up to the present time the plant has never suffered from shortage of water, and when the regulation of the upper waters has reached the maximum efficiency, the dependable flow may reasonably be assumed to be in the neighborhood of 1,000 second-feet, of which about 750 second-feet could be used by the Power Company under its lease. Under a head of 26 feet, this would generate 1,775 hydraulic horse-power, and as there is about five square miles of storage area tributary to the head-works, the plant would easily carry 2,000 h.p. or more on peak load.

The Company has under consideration an addition to the plant which will double its present capacity, and in view of the above such a step would seem to be justifiable in so far as the hydraulic capacity of the site is concerned.

Estimates.

The estimates presented herewith are based on two assumptions; first, that the plant be operated in its present condition and at the present rates for one year; second, that \$70,000 additional be expended at once in improving the plant and doubling its present capacity. The surplus shown in each case is based on the Company's actual revenue for 1910, and with a normal expansion of business for 1911, the actual surplus could reasonably be expected to exceed the figures given in the estimates.

Outside of interest, sinking fund and depreciation, the annual charges in the attached estimates are based on the Company's 1910 balance sheet, the different items being altered in some instances to suit new conditions.

As regards operating the plant in its present condition it must be borne in mind that the operation involves a certain amount of risk as to continuity of service, since the plant has no reserve capacity under peak load conditions. Ordinarily, operation under such a condition could not be recommended; but in this case it happens that the plant owned and operated by the Municipality of Fenelon Falls is situated directly across the river from the plant of the Lindsay Light, Heat and power Company, and there is a mutual agreement between these two for interchange of power in case of breakdown. For this reason, the Town of Lindsay might with a reasonable amount of risk obtain satisfactory service from the plant in its present condition, disregarding, of course, the possibility of a protracted shut-down due to destruction or serious injury to some portion of the plant. Operating on this basis, the estimate indicates that the resulting annual charges would be \$26,629 and the surplus, based on last year's revenue, would be \$10,920.

In estimate No. 2, the \$70,000 additional investment would largely eliminate all danger of serious interruption of service, and at the same time double the capacity of the generating plant. The total annual charges would then be \$32,479, and the surplus, based on last year's revenue, would be \$5,070.

Owing to the fact that the Company's present cash reserve will not be available to the Town in the event of purchase, it is proposed to re-establish this fund out of the surplus which will be realized from one year's operation of the plant at the present existing rates. As above shown, this fund at the end of the year's operation would amount to \$10,920 under the first estimate, or to \$5,070 under the second estimate.

Taking into consideration existing conditions, it would seem that the Town could reasonably undertake to operate the plant in its present condition for a year, and the resulting surplus carried to rest would put the system on a safe financial basis. The attention of the management could thereafter be given to improvement of plant, extension and improvement of service, and to reduction of rates.

Estimate No. 1.

Based on assumption that plant is operated for one year in its present condition and at existing rates, relying on the Fenelon Falls Municipal plant for reserve power.

<i>Capital Cost:</i>	
Purchase Price	\$230,000 00
<i>Annual Charges:</i>	
Annual Renewals and Repairs	\$1,350 00
Insurance	375 00
Right-of-Way Rental	300 00
Taxes	1,000 00
Rent	150 00
Depreciation charge on Existing System	4,464 00
Operation and Administration	4,500 00
Interest, 4½% on \$230,000.00	10,350 00
Sinking Fund, 1.8% on \$230,000.00	4,140 00
	<hr/>
	\$26,629 00
Revenue for 1910	37,549 00
	<hr/>
Estimated Surplus	\$10,920 00

Estimate No. 2.

Providing for the expenditure of \$70,000 on capital account immediately upon assuming control of the present system, thereby doubling the capacity of the generating plant.

<i>Capital Cost:</i>	
Purchase Price	\$230,000 00
Additional Plant and Improvements	70,000 00
	<hr/>
Total Capital Investment	\$300,000 00
<i>Annual Charges:</i>	
Annual Renewals and Repairs	\$1,350 00
Insurance	400 00
Right-of-Way Rental	300 00
Taxes	1,000 00
Rent	150 00
Depreciation Charge on Existing System	4,464 00
Depreciation Charge on Additional Plant	915 00
Operation and Administration	5,000 00
Interest, 4½% on \$300,000.00	13,500 00
Sinking Fund, 1.8%, \$300,000.00	5,400 00
	<hr/>
	\$32,479 00
Revenue for 1910	37,549 00
	<hr/>
Estimated Surplus	\$5,070 00

Lindsay Light, Heat and Power Company.

Plant located at Fenelon Falls.

Operating head, 24 ft.

Capacity installed, 1,100 h.p.

Transmission distance to Lindsay, 14 miles.

Permanent Works :

Brick power-house.

Concrete canal retaining-wall.

Wooden dam built by and controlled by Trent Valley Canal System.

Hydraulic Equipment :

2 Turbine units, each consisting of one pair of 40 in. Samson wheels.

Steel wheel-case, horizontal setting, central discharge, steel draft tube.

2 size C. Woodward governors.

1 Exciter turbine, 20 ins. single Samson, horizontal setting.

Electric Equipment : (Power House)

2-400 kw. C.G.E. Generators, class 36-400-200, 3 phase 60 cycles, 550-605 volts, 382 amperes. Revolving armature, 200 rev. per minute.

1 Exciter generator, 20 kw. 125 volts, 160 amperes. Speed 385 rev. per minute.

6 transformers, 135 kw. single phase, 60 cycles, type A.B. air-cooled, 550 to 11,620 volts. One bank operating on each transmission circuit.

1 motor-driven Buffalo Forge Co. blower attached to each bank of transformers.

Switchboard :

2 generator panels, 2 transformer panels, 1 exciter panel, 1 synchronizing panel, 2 line panels, 1 ground detector panel. All equipped with necessary switches and instruments.

Transmission Line :

Route lies along the Lindsay-Haliburton branch of the G.T.R. Cedar poles spaced 95 ft. average. Two three-phase circuits erected composed of No. 4 B. & S. copper. Circuits mounted on one 4-pin and one 2-pin crossarm, one circuit on 12,000 volt porcelain insulators and one circuit on 11,000 volt glass insulators. Each circuit equipped with a set of Garton-Daniels lightning arresters. One barbed ground wire mounted on top of poles, and grounded every third pole.

Sub-Station :

Building of brick. Not built for present purpose, but was taken over from the Gas Company.

6 transformers, 135 kw., oil cooled, 10,600 to 1,100 volt. One bank operating on each transmission circuit. Switchboard—2 line panels, 2 transformer panels, 2 oil switch panels, 4 distribution panels. All equipped with necessary switches and instruments.

Arc Equipment :

3 tub transformers, 21 kw., 60 cycles, 1,100 volts 6.6 amperes, secondary.

3 Arc panels, type A.S.C.T., oil switch and instruments.

The most objectionable feature in connection with the plant at the present time is the lack of spare generators and transformer capacity, as it requires practically the full rated capacity of the plant to carry the maximum peak.

Up to the present time any shut downs that have occurred have been in the summer during periods of light load, and the Company has been unusually lucky up

to the present time, in being able to supply continuous power during periods of maximum demand.

The present arrangement of the generating plant is also rather objectionable in that the wheels are so located that they are not easily accessible for inspection and repair. This objection could be obviated at a reasonable cost by making some alterations in the power-house building.

Both generators are of the old revolving armature type, and while they are giving good service at the present, they would probably have to be disposed of at scrap valuation when it becomes necessary to replace them.

The transmission line is not by any means a first-class piece of construction. The location on the railway right-of-way makes necessary the introduction of a large number of angles and curves which could have been eliminated to a certain extent had a private right-of-way or a road allowance been used. No serious trouble has resulted so far from this construction, although at Cameron station, the station structure and a large barn are located directly beneath the line, and in the event of either of these buildings catching fire, the adjacent poles would undoubtedly be burnt, and the system temporarily paralyzed.

The sub-station equipment in Lindsay is located in a building purchased from the Gas Company, and is of course not well adapted for use as a sub-station. The building is deficient in head room, and while the obtainable clearances are sufficient for the present voltage, radical changes would require to be made in the construction of the building to adapt it for higher voltage. Apart from the lack of spare transformer capacity, there are no inherent defects in the station which would effect continuity of service under present conditions, the principal disadvantage being the lack of facilities for the quick repair and handling of heavy apparatus. In order to be able to guarantee reasonable continuous service, the Power Company would require to have to make the following additions and alterations:—

(1) Install another generating unit in the power station at Fenelon Falls, with a capacity at least equal to that of each of the units at present installed.

(2) Install another exciting unit, preferably driven by an independent turbine.

(3) Install an extra transformer in the generating station, and one at the sub-station.

(4) Make such alterations in the power-house as will be necessary to place the turbines on a proper foundation, and make them easily accessible for inspection and repairs.

(5) Deflect the transmission line at Cameron station to avoid the station building and barn, or else remove the buildings from underneath the line.

The dam at Fenelon Falls is in poor repair but is controlled by the Trent Valley Canal. It is reported that this dam is to be replaced in the near future and the height probably increased.

The Power Company holds a perpetual lease from the Department of Railways and Canals by virtue of which they are entitled to the use of all water, for power purposes, over and above that required for the uses of navigation.

When the Power Company secured this lease from the original Lessees, one quarter of the surplus water had been assigned in perpetuity for mill privileges on the other side of the river. The Power Company, is, therefore, by virtue of this assignment, entitled to only three-quarters of the total quantity of surplus water.

April 10, 1911.

REPORT NO. 10.

Peterboro.

The Otonabee River is the natural source of power for the City of Peterboro, and flows through the Corporation limits. The river is part of the Trent system, being on the route of the Trent Valley Canal, and the storage system which is being established in the upper waters by the Department of Railways and Canals is having an appreciable effect upon the flow of the river, and constantly increasing its value as a source of power.

Available Flow—Power Capacity.

Unfortunately no interconnected series of gaugings and gauge-height records are in existence, so that it is impossible to obtain reliable data as to the flow characteristics, all available figures relating to minimum flow being largely a matter of individual estimate, based on isolated gaugings. As a result there is considerable divergency of opinion as to the present minimum flow and the greatest possible minimum flow with storage.

Estimates of present minimum flow vary from 1,100 to 1,500 second-feet and from 1,500 to 2,500 second-feet with storage. The figures for the present minimum flow are based on the gaugings above mentioned, but the amount of minimum flow with storage is merely a surmise. From the load sheets of plants operating at the present time in Peterboro, it has been established, however, that there is at least 1,400 second-feet available for peak load purposes whenever required, and while the actual minimum flow probably falls below this at times it would be safe to assume 1,400 second-feet as being commercially available at present, with 2,000 to 2,500 second-feet a future possibility.

Basing hydraulic construction on this assumption, it would be safe to install generating equipment to handle 1,500 second-feet, and power house and head works to sufficient capacity to handle a future flow of 2,000 second-feet.

The portion of the Otonabee River which flows through Peterboro is not on the main line of the Canal, which leaves the River at Nassau Bridge, 4 miles above Peterboro, and enters it again just below the Peterboro lift-lock. On this section of the river the head due to the natural slope has been concentrated by means of dams owned and operated by private interests, the flow, however, being regulated by the Canal authorities. Between Nassau and Lakefield the river has been canalized and all dam and lock construction is under the control of the Trent Valley Canal, as are also the resulting heads and water levels.

All the water-powers in this portion of the river are either in the City or within ten miles of it, the most remote location being at the Village of Lakefield. The following is a list of these powers, their power capacity being based on an available minimum flow of 1,400 second-feet.

Quaker Oats Company, Peterboro	3,400 h.p.
Auburn Dam	1,900 "
Peterboro Waterworks	1,500 "
Canadian General Electric Co., Nassau	1,900 "
Dam No. 5 } Otonabee Power Co.	3,300 h.p.
Dam No. 4 }	
Dam No. 3 Canada Cement Co.	1,500 "
Dam No. 2 Unallotted	1,300 "
Dam No. 1 Lakefield (Dixon Bros.)	2,000 "
Total	15,800 h.p.

Available Sites.

The first four locations in the above list are not on the market, but the city has an opportunity to acquire complete control of the power situation as represented by Dams Nos. 1, 2, 3, 4 and 5. These powers have a present aggregate capacity of about 8,000 h.p., and a probable future capacity of 11,000 h.p. It would probably be commercially feasible to develop these powers in rotation in accordance with the market requirements of Peterboro and Lakefield.

Preliminary Development.

The capital outlay which would be necessary to acquire control of all the power embraced in this scheme precludes the possibility of considering the proposition as a whole at the present time, but there is no reason why the municipality should not give careful consideration to the preliminary steps necessary for the consummation of the general scheme. The first step is naturally the selection of the most favorable site for initial development, and in this connection it would seem that if any question of choice is involved it lies between the Otonabee Power Company's site at Dams No. 4 and No. 5, and the Dixon property at Dam No. 1 in the village of Lakefield. An analysis of these two propositions is made hereunder with the object of demonstrating as fairly as possible which has the better claim for consideration from a commercial and engineering standpoint.

Flow.

The Otonabee site is situated some five miles lower down on the river than the Dixon site, and has consequently a greater area of watershed behind it. This advantage is so small, however, that at present both sites can be considered on a par as regards available flow.

Head and Power Capacity.

The present normal head at the Dixon site is 16 feet, but during the winter season the level below the dam could be drawn down so as to give a head of 20 feet. At the Otonabee site a head of 26 feet is available all the year round. The matter of allowing a 20 foot head at the Dixon site is entirely at the option of the Canal authorities, so that on the basis of dependable head the Dixon site has a power capacity of 2,000 h.p. under present conditions, and a probable future capacity of 3,000 h.p., while the Otonabee site has a present capacity of 3,300 h.p. and a probable future capacity of 4,700 h.p. In this instance, therefore, the advantage lies decidedly with the Otonabee site.

Rights Under Lease.

The Dixon property is held under a lease which allows the use of surplus water without other restriction than is laid down in the general conditions on the lease. This lease is renewable every 21 years in perpetuity in consideration of payment of \$2.00 per year rental. The Lessees under this lease are not given the right to transmit electric energy.

The Otonabee property is held under a lease which allows the use of all surplus water subject to the general condition of the lease, with an additional restriction to the effect that, should the Trent Canal be improved or enlarged, any increased volume or flow of water which might thereby become available should not be considered surplus water within provisions of the lease nor accrue to the benefit of the lessees.

This lease is renewable for three periods only of 21 years each, the final date of expiry being at the end of the third term, and the rental is said to be \$2,100 per year. Under this lease the lessees are given the right to transmit electric energy.

As regards rental and the use of surplus water the Dixon lease is undoubtedly the more advantageous. The Otonabee lease has an advantage in that it permits the transmission and sale of electric energy, but in the event of the City of Peterboro taking over either of these propositions a satisfactory adjustment of the above-mentioned restrictions could doubtless be arranged.

Conditions of Purchase.

The Dixon property has been offered to the City for \$200,000. For this sum the City would obtain the unrestricted right to use all surplus water passing and to pass through the flood-gates of the Lakefield Dam, and to install works to develop such power as this surplus water will generate under a 16 foot head.

The property of the Otonabee Power Company has been offered to the City for \$225,000. For this sum the City would obtain the right to use all surplus water at Dam No. 4, subject to the conditions and restrictions above mentioned, and the right to install works to develop such power as this surplus water will generate under a 26 foot head. In addition to this, the City would acquire the present 1,500 h.p. plant at Dam No. 5, a 6,600 volt transmission line to Peterboro, a sub-station in Peterboro, a distribution system covering practically the whole city, and a connected load of 1,250 peak horse-power.

The Dixon offer means simply the assignment of a lease. The Otonabee offer includes not only the assignment of a lease, but a complete generating, transmitting and distributing system, handling a load of 1,250 h.p., and capable of handling a load of 1,500 h.p. with very little additional expense.

Development.

The development of the Dixon site involves the building of a generating station, 10 miles of transmission line, a sub-station and a complete distribution system throughout the City of Peterboro, including pole lines, circuits, service transformers and meters. The development of the Otonabee site would involve only the building of a generating plant and the erection of such extra copper as would be necessary to distribute a preliminary 2,700 h.p. economically.

Apart from comparative capital costs, the mere fact that the streets of the city would be obliged to carry a new distribution system, assuming that this is physically possible, would be sufficient to place the advantage with the Otonabee site. In addition to this, the fact that the transmission distance is only 5 miles as compared with ten miles from Lakefield is distinctly to the advantage of the Otonabee site as regards continuity of service.

Costs.

The attached estimate indicates that 2,700 h.p. continuous 24 hour power can be delivered to the customer in Peterboro for an average price of about \$16 per h.p. from the Otonabee site. An approximate estimate of costs with reference to the Dixon site indicates that 2700 h.p. could be delivered to the customer in Peterboro for practically the same price as 2700 h.p. from the Otonabee site. As the load approached its ultimate capacity, the advantage would therefore lie more and more with the Otonabee site, and more so as the 2,700 h.p. delivered from Lakefield would require the maximum possible development at the Dixon site.

Market.

If the City took up the Dixon offer it would involve the creation of an entirely new market, with the Otonabee Power Company as a competitor, and also the duplication of distribution lines throughout the city. By buying out the Otonabee Power Company, its competition would be eliminated, a ready-made market would be obtained and the necessity of duplicating the distribution system would be avoided.

Of the points considered above, the most important are: (1) rights under lease, (2) available present flow, (3) annual costs, (4) power capacity, (5) market conditions.

In the matter of rights under lease, the Dixon property at present has the advantage. In the matter of present flow, both propositions are on equal terms. On all the other counts the advantage lies with the Otonabee property.

In view of the above, the conclusions are: (1) If, as seems possible, a perpetual lease to the Otonabee site can be obtained at the present or at a less rental, and if reasonable assurance can be given that no drastic action will be taken in restricting the use of additional surplus flow, then the Otonabee proposition is unquestionably the best; (2) if the terms and conditions as set forth in the present lease were strictly enforced, conditions would still throw the balance in favor of the Otonabee site.

Conditions of Otonabee Lease.

The development rights under which the present plant of Otonabee Power Company operates are held by virtue of a lease taken out on August 1st, 1901, by Messrs. W. E. Meldrum, W. A. Stratton, and R. R. Hall, and later assigned to the Otonabee Power Company. The outstanding features of this lease are as follows:—

(1) It imposes a fixed rental of \$1,264 per year for land and surplus water, (2) the life of the lease is for three terms only of 21 years each, the date of expiry being August 1st, 1964, after which date the question of renewal rests solely upon the decision of the Governor-in-Council, (3) Clause 13 of the lease stipulates that should the Trent Canal during the term of the lease be improved or enlarged, any increased volume or flow of water thereby made available shall not be considered surplus water within the provisions of the lease, nor accrue to the benefit of the Lessees, (4) Clause 14 of the lease stipulates that upon the expiry of the second 21 year term of lease, the rental for the final term may be fixed "at any greater or other rate than herein reserved," said rental to be fixed by and at the option of the Governor-in-Council.

This lease covers only the present site of development at Dam No. 5, and a lease will, of course, have to be obtained, covering the combined development of Dams No. 4 and No. 5. This new lease had not been issued when inquiries were made early in March, but it is reported to have been issued recently and to call for a yearly rental of \$2,100 for the combined development. For lack of more definite information, it is assumed that the important clauses in this new lease are similar to those in the old lease as above described. The new lease must also include the right to use some 41½ acres of canal lands which the plant will occupy.

The amount of yearly rental and the limitation of the term to 64 years does seriously impair the value of the lease, but the restriction as to the use of surplus water should be looked into closely. If the phrase "improved or enlarged" can be interpreted as applying strictly to the waters forming the navigable channel of the canal, and the locks, dams and other constructed works in connection therewith, then this clause imposes no greater restriction upon the Lessee than Article No. 21 of the General Conditions which accompanies all leases issued by the Department of Railways and Canals. If, on the other hand, this phrase "improved or enlarged" is intended to cover the storage works in the upper watershed, the restriction will have a serious effect both from an engineering and an economic standpoint, and a definite understanding should be arrived at before any attempt is made to carry the scheme into execution.

Scheme of Development.

The contemplated scheme of development at Dams No. 4 and No. 5 involves the combination of the two heads by taking the water from above Dam No. 4 and discharging it below Dam No. 5. This diversion will entail the construction of about 2,800 feet of head-race, and all the private property required for same has been purchased by the Otonabee Power Company. A plan showing the general lay-out of the plant has been prepared and approved by the Superintending Engineer of the Trent Canal, and indicated upon this plan are the several blocks of canal lands which would require to be demised or leased to the Company for the construction of the power-house and head-works. The Canal authorities are considering the possibility at some future time of using the head-race of the new plant for navigation purposes by substituting a new lock of 26 foot lift for the two locks of 12 and 14 foot lift at present existing. In this event the head-race would require to have a much greater cross-section than if it were used for power purposes only, and two courses of action are open, namely, to construct at the outset a head-race of sufficient cross-section to accommodate the navigation and power interests, the Department of Railways and Canals bearing a just proportion of the cost, or to allow the construction of a head-race for power purposes only, on the understanding that the Department of Railways and Canals may at some future time, at its own expense and without interrupting the power service, widen the head-race sufficiently to adapt it for navigation purposes. This question should also be settled before any steps are taken to carry the scheme through.

Estimating Data.

In January, 1909, an estimate was prepared for the Otonabee Power Company by a well-known firm of consulting engineers, covering the cost of developing the site at Dams No. 4 and No. 5 for a future installed capacity of 4,000 h.p. and a preliminary installation of 2,700 h.p. A detailed survey was made of the site, complete plans were prepared, and manufacturers' quotations obtained for the different classes of equipment. This complete working estimate has been finally revised to meet the requirements of the canal authorities, and the figures derived therefrom have been used in the general estimate hereto attached.

The existing transmission line consists of a line of wood poles with two 3-phase circuits of No. 1 copper. This copper has a carrying capacity of 2,500 h.p. with 6 per cent. loss, and the line is in good operating condition, so that at the present time no expenditure for transmission is necessary outside of the purchase price.

The Peterboro sub-station is a substantial brick building centrally located in the town and contains 2,000 h.p. rated transformer capacity, stepping down from 6,000 to 2,300 volts, with the necessary switching equipment.

The distribution system completely covers the residential, business and industrial sections of the city but the copper at present erected is not of sufficient capacity to handle more than 1,500 h.p. economically. Some of the larger blocks of power are also located at a distance from the station, so that heavy expenditure in copper would be necessary for serving at 2,200 volts. It has, therefore, been considered advisable to serve such customers by means of a separate 6,000 volt power circuit stepping down at the point of load to motor voltage. The pole lines at present erected are in good shape and the poles are long, so that no difficulty is anticipated in connection with the erection of the extra power circuit. In the general estimate attached allowance is made for the erection of the necessary extra copper, cross-arms, insulators and transformers. An allowance is also made for the building of such new lines as would be necessary to serve new customers not located within the limits of the present system.

The installation of this 6,000 volt power circuit will not only mean a saving of copper, but it will obviate the necessity of immediately increasing the sub-station transformer capacity, as the 2,000 h.p. capacity already installed will handle the lighting and small motor load for some time to come. The system, extended as above described, will easily handle a load of 2,500 h.p.

The attached estimate allows for the necessary 6,000 volt selector switches and a complete equipment of switchboard instruments in the sub-station.

In the estimate of Annual Charges, the maintenance and depreciation are based upon the estimated first cost of such portions of the present plant and equipment of the Otonabee Power Company as will be utilized, and in addition the charges on all new plant. The operating costs of the new system should not be appreciably greater than those at present, but as information in this connection



"The Black Hole" Maitland River.

has not yet been obtained from the Company, the figure given is merely estimated. All other items in the estimate are self-explanatory.

Sale of Power.

The estimates show that 2,500 h.p. could be sold for an average price of \$17.55 per h.p. per year. This refers to continuous 24 hour power and does not take into account the possibility of re-sale of 10 hour power, or the possibility of supplying a connected motor load of say 2,000 h.p. with 1,500 h.p. station capacity. Allowing for re-sale of power and over-selling of capacity, it would be entirely safe to assume that the enlarged system could carry a load of 3,000 h.p. to 3,500 h.p., with 2,500 h.p. capacity installed. The lesser figure of 3,000 h.p. would therefore reduce the average price to \$14.65 per h.p. per year for 10 hour power.

All the lighting and power business is at present handled by the Company on a flat rate, and all present users of power, who are under contract, should be held to the present rates, during the term of their respective contracts, and all new

power business should be taken at a revised rate to be based on load-factor, and on the annual charges for which the City would be liable in the event of its carrying out the proposed scheme.

All new lighting business should be handled on a meter basis, but at the outset the flat rate light users should have the option of coming in under the meter rate or continuing on the flat rate basis until such time as the revenue from metered light is great enough to allow of a definite decision as to whether or not the lighting load shall be placed on a meter basis exclusively.

Scope of Report and Conclusions.

It is to be noted that the scope of this report does not cover the discussion of present rates or of rates to be charged in the future, this being a question to be taken up later in detail. The function of this report is to indicate the most favorable location for development from an economic and engineering standpoint, and, having established this, to show what capital investment will be necessary to develop and deliver power to the customer. Also to what annual charges such delivery will entail, and to indicate an average price for which the output of the preliminary installation of 2,700 h.p. must be sold to cover said annual charges.

The capital cost for full generating capacity will be about \$193,000, and assuming \$150,000 of the purchase price chargeable to the generating portion of the system, the total capital cost of power at the switchboard would be \$343,000 or \$86.00 per h.p. on the assumption that 4,000 h.p. can be ultimately developed. On this basis the price asked by the Company is not unreasonable.

The capital cost and annual charges for 4,000 h.p. capacity have not been included in this estimate for two reasons: first, because the restrictions of the lease make it uncertain as to whether sufficient surplus water will be available, and, secondly, because if it can be shown that the city can handle the preliminary development of 2,700 h.p. profitably, the success of the scheme is assured, and any increments of generated power would, when sold, tend always to reduce the average cost of production, the result being either an increase in the city's profits or a reduction in cost to the consumer.

An estimate for full capacity would also require an allowance for further extension of the distribution system, and this cannot be estimated upon at present with any degree of accuracy. If the city sold power at cost, the additional investment for extension would be covered by an additional loan. If the city sold power at a reasonable margin above cost, extensions could be made as required and the cost defrayed out of revenue.

In the meantime, the estimates as submitted indicate that the annual charges incident to the development and sale of 2,700 h.p. can be covered by selling power at a very reasonable price. This being the case, the continued success of the scheme would seem to be inevitable, and all consideration as to the cost of power when the ultimate capacity of the site has been reached can safely be left over until market requirements make such consideration necessary. The present conclusion is that the Otonabee site at Dams No. 4 and No. 5 is best suited for the city's purpose, and that the city could well afford to pay \$225,000 for the Otonabee Power Company's complete system and develop the site at Dams No. 4 and No. 5, providing a market of 2,500 h.p. is in sight.

No information is at hand concerning the volume of business handled at present by the Otonabee Power Company, but it is reported that their gross yearly earnings are in the neighborhood of \$30,000, this being derived from a load of 1,250 h.p. on the peak. If the city can hold this business while developing a market

for the balance of power, it will go a long way towards obviating the possibility of a deficit in the first year's operation.

The figures for power development in the estimate below include the whole cost of the head-race, core-wall and embankment and the necessary excavation, but if this channel is to be used in the future for navigation purposes the Canal authorities might reasonably be asked to stand at least a portion of the cost of this part of the work, which amounts to \$43,000.

Estimate of capital investment necessary to buy out the Otonabee Power Company and to generate, transmit and distribute 2,700 h.p. in the City of Peterboro.

Power Development:

Dredging, Excavation, Unwatering, etc.	\$39,950 00	
Concrete	31,400 00	
Brickwork	2,100 00	
Embankment Protection	4,000 00	
Steel and Iron	6,180 00	
Woodwork	1,805 00	
Roof	690 00	
Gate Mechanism	175 00	
Grading, Fencing, and Railway Spur	3,000 00	
Painting	450 00	
Crane	1,100 00	
Hydraulic Equipment	29,200 00	
Electrical Equipment	14,700 00	
Switchboard, Wiring, etc.	4,700 00	
		\$139,450 00
Engineering, Contingencies, Superintendence, 20%..		27,890 00
		\$167,340 00

Extensions and Additions to Distribution System:

Wire and Cable	\$7,710 00	
Poles, Crossarms, and Insulators	312 00	
Service Transformers	9,000 00	
Meters	5,000 00	
Switching Equipment	3,000 00	
		\$25,022 00
Purchase Price		225,000 00
Grand Total		\$417,362 00

Note.

The estimate for electrical equipment includes the cost of one new generator and cost of moving the old generator to the new plant.

The items "Service Transformers" and "Meters" are to cover the cost of installing services for the new power customers on the 6,000 volt power circuit and to instal service for new customers on metered light.

Annual Charges:

Interest, 4½% on \$417,362.00	\$18,781 00
Sinking Fund, 1.8% (30 year) on \$417,362.00	7,512 00
Maintenance and Depreciation on Generating Plant	4,437 00
Maintenance and Depreciation on Transmission Line	388 00
Maintenance and Depreciation on Distribution System..	2,620 00
Power Rental	2,100 00
Operation and Administration	8,000 00
Total Annual Charges	\$43,838 00

Continuous 24-hr. Service:

Average Cost, on basis of 2,500 h.p. delivered	\$17.55 per h.p.
Average Cost, on basis of 2,750 h.p. delivered (10% overload)	15.95 per h.p.

Limited Hour and 10-hr. Service:

Average Cost, on basis of 3,000 h.p. connected load....	\$14.65 per h.p.
Average Cost, on basis of 3,500 h.p. connected load....	12.55 per h.p.

April 5th, 1911.

13 H.

REPORT NO. 11.**Lakefield.**

Relative to the supply of 400 h.p. on which the Village of Lakefield has requested the Commission to submit a price, it appears that at the present time the nearest existing development from which it might be possible to secure such supply is the Otonabee Power Company, which has a plant at dam No. 4, about 6 miles below Lakefield on the Otonabee River. This company is at present, however, supplying light and power to Peterboro, and it is doubtful if they have sufficient spare capacity to supply the needs of the Village of Lakefield. The natural source of supply for this municipality is dam No. 1 on the Otonabee River, which is located within the corporation limits of the village. This site is owned and has been partially developed by Dixon Bros., of Lakefield, lumbermen, and a small electric plant has been operating there for some years. It would seem that the proper course to pursue would be to either make arrangements with the present owners to develop this site to a sufficient extent to supply the requirements of the corporation, or to arrange for the corporation to purchase the site outright from the present owners.

A development at this location is now being considered in conjunction with the general consolidation scheme for all the developed and undeveloped power locations on the Otonabee River, between the Peterboro Waterworks dam and Dam No. 1 at Lakefield. This scheme involves six projected developments, having an aggregate capacity of 8,300 h.p.

It might be well to send a representative to Lakefield to ascertain the town's attitude in the matter, determining in particular whether or not the town is willing to wait while the consolidation deal is consummated, or whether they wish to purchase the Dixon site.

January 23rd, 1911.

REPORT NO. 12.

Erindale Power Co.

I beg to report that having made an investigation of the plant and lines of the above company, I find the same apparently satisfactory from a construction standpoint. The power plant at Erindale is practically completed and is operating at the present time under a 53 ft. head, which will be increased to 60 in a short time, as soon as the main dam has been completed. This dam, while rather rough and unworkmanlike in construction, is, as far as could be ascertained at the time of inspection, safe enough for ordinary purposes providing the spillway capacity is sufficient. The power-house and wheel chambers are of substantial concrete construction. The generators, which were manufactured by the Allis-Chalmers-Bullock Co., and the switchboard, which is equipped with Ferranti instruments, are both in good operating condition.

The Manager and Chief Engineer of the company claim that the minimum flow of the Credit River at Erindale will not fall below 75 cu. ft. per second. They base this assumption on the reports of various engineers and upon measurements made by Mr. Henry, the chief engineer of the company. While the company appear to be satisfied that this figure is correct, I find it very hard to believe, and am inclined very strongly to the belief that the minimum power will at times be less than half the 400 minimum 24 hour horse power which they claim. This, of course, is a matter which requires investigation in the field and we are not in a position as yet to make an authentic statement with regard to the minimum flow of the Credit River.

The Manager of the company admits himself, however, that it will be necessary to provide auxiliary power from some other source at some seasons of the year to carry their connected load, and for this reason application is made by the company to the Commission for the supply of this auxiliary power.

This auxiliary power is at present supplied by the combined steam and hydraulic plant of the Interurban Electric Co., near Lambton, which is under the same control as the Erindale Power Co. It is for the purpose of dispensing with the Interurban plant that the Erindale Power Company purposes to take power from the Commission, as this plant is poorly arranged, badly situated, and the operation is expensive and unsatisfactory. A complete description of this plant, and also of the plant of Erindale Power Co., is contained in the report of the Chief Engineer of the Company.

The Interurban Electric Company has a franchise in Toronto Junction and West Toronto, which has nine (9) years to run, and the Erindale Power Company has a 25 year franchise in the Townships of York and Etobicoke.

February 1st, 1911.

REPORT NO. 13.**Dog Lake Dams.**

Pursuant to instructions received by telegram on March 19th, I proceeded to the site of the work at Dog Lake on Monday, March 20th, in company with Mr. Halford, engineer of the Public Works Department, who went in at the same time to report on the completion of the work, independently, to his Department. We met the resident engineer, Mr. Sedgewick, and proceeded over the work with him, obtaining information on the method of procedure and the character of the work which was not visible. The dams were inspected in order and we are pleased to report on the condition of the work as follows:—

Dam No. 1.

This is an overflow dam and was built on the site chosen and in accordance with the plans, with such exceptions as are noted below.

The excavation for this dam was in excess of that called for on drawing. This work was done on the instructions of our engineer to secure a good foundation and prevent seepage through fissured rock and excavation is from one foot to eighteen inches in excess of that shown on drawing. The excavation was completely filled with concrete, and parts outside of dam formed a toe for same. The concrete is uniformly satisfactory with suitable surface for the service intended. Flash boards to the height of two feet were in place and supported by the posts driven in the four inch pipe as called for on drawings.

Dam No. 2.

The regulating dam is also built in accordance with plans. The excavation for abutments was increased to obtain a better footing and to prevent seepage through fissured rock. The excavation between abutments was filled with concrete to the height of the sills, and this was carried out from one to three feet beyond the heel of abutments forming an apron. The concrete was good although the form work has been rough. The excavation in either end of dam was in excess of that called for in the drawing, necessitating increased quantities of concrete in the wing walls. This work has been done satisfactorily and care was taken in obtaining good rock foundations to render the dam safe. The rock excavation for entrance to regulating dam and the excavation for tail water has been neatly made and is sufficiently cleared to give good entrance and run off. This work is satisfactory. The rock fill in wing walls has been done according to specifications. The steel for flooring, guides, etc., has been placed properly and appears well anchored. The stop logs have been made in accordance with the plans, and while no attempt has been made to dress the rough sawn timbers, the logs in place do not show very much leakage. The flooring is roughly placed but serviceable and secure. The Contractor has double sheeted the main flooring, where only one thickness is called for.

Two pair of regulating sluice gates have been placed in the dam. These are in operating condition. The setting of guides and supports for regulating wheels does not show the best workmanship, but should answer the purpose for which they are intended and are serviceable.

The concrete work is satisfactory and appears to be in good condition.

Dam No. 3.

A rock fill dam with concrete core located across the N. E. outlet. This dam has been constructed in accordance with drawings, with the exception that the excavation for foundations was much greater than expected, on account of the poor rock found at the site. This was all cleared away until good foundations were obtained. The concrete core contains about 200 cu. yd. of concrete in excess of that estimated from plans. The rock fill on the up stream side is satisfactory. The rock fill on the down stream side is of a similar character, although the specifications call for a more careful placing of rock than in the case of up stream side, which was random fill. The down stream fill is, therefore, not as compact as the specifications called for, but appears to have ample weight to insure stability. The diaphragm had been placed in front of core wall and forms left on.

Dam No. 4.

This is a wing dam built where originally located along a rock ridge, but has one more angle than the plan shows. The excavation was made to rock, along its entire length, and good foundations secured for the core-wall. The core-wall at the deeper section showed three expansion cracks, these do not appear to be serious and will silt up. The concrete for 15 to 20 feet on north end of core-wall, and two feet above high water mark, was not good, but this does not affect the dam and might have been left out in the first place. They are going to remove this stretch, however, and replace with good concrete, the material being on the ground for this purpose.

The concrete for 15 to 20 feet on north end of core-wall, and two feet above high water mark, was not good, but this does not affect the dam and might have been left out in the first place. They are going to remove this stretch, however, and replace with good concrete, the material being on the ground for this purpose.

The rock fill on both sides is satisfactory and shows more care in placing than that of No. 3. This dam was built by the Government on a cost plus basis, with the result that the cost per unit is in excess of that for other dams. All work has been carried on in accordance with the specifications with the exception noted. In general, although the workmanship has not been of the best, the work will be serviceable and will perform the function for which it was intended.

As the complete data on costs, and the data on the work as it has been constructed was not immediately available we have instructed the resident engineer to report to this office as soon as all the data on the work and its cost has been collected. This information is desired to complete our files on this work.

It will be well to watch the action of the water on the unprotected abutments of the regulating dam, and should they show signs of erosion, to have them protected by timber or sheet steel. From observations on the site this protection does not seem to be necessary at the present time.

The Contractor and his outfit have left the work.

March 28th, 1911.

REPORT NO. 14.**Dog Lake Dams.**

The elevation of Dog Lake on July 4th, at 10.30 a.m., was found to be 1,376.60 ft., and on July 6th, at 9.30 a.m., 1,376.72 ft., the water having risen 0.12 feet in 47 hours. These elevations were taken on still water at the east end of the regulating dam.

A water-gauge was made and placed at this dam so that readings might be taken by Fire Ranger Gammon each time he is in that vicinity, and recorded on sheets left him for that purpose. Mr. Gammon will also take measurements of the height of screws at each gate, which will indicate the discharge.

It was found on inspection that at gate No. 2 the 1½ in. rod used to open or shut the gate had been buckled in such a way as to allow the gate to be almost wide open, while the measurements of the height of screw would indicate it to be only slightly open. The discharge, therefore, cannot be accurately determined until this rod is replaced. The great weight of water no doubt has forced this gate open, thus buckling the rod.

Elevations were taken of the rock fill at each of the other dams, and it was found that these fills had sunk considerably, especially on the up-stream side.

Some measurements and elevations were also taken at the Indian Village on the Dog River at the head of Dog Lake. There were eleven buildings in all, built of logs and very old, one having no roof at all, and all in more or less dilapidated condition. These houses are said to have been formerly owned by the "Hudson Bay Co.," and after they had abandoned the post were taken up by the Indians. They are situated upon a slight eminence, and surrounded by the river on one side, and low-lying swamp on the other three sides, and there is no ground nearby to which the houses could be moved.

The Indians, having deserted the village, are now living in tents and the village will probably be inundated when the water has risen two feet more. There is every likelihood that it will rise much higher than this if the present rate of increase continues throughout the summer.

July 12th, 1911.

REPORT NO. 15.

Waddington.

The Commission's hydraulic engineer visited Waddington on Thursday, March 30th, and made a careful investigation of the natural conditions existing in the neighborhood of the proposed development of the New York and Ontario Power Company at Ogden's Island. The main channel of the river along the outer shore of Ogden's Island is wide, the cross section being fairly uniform, the velocity being from 3 miles an hour at the head of the island to probably 6 miles an hour at the lower end. This practically obviates all possibility of a jam in this portion of the river, which might have a tendency to raise the head water in the inner channel and flood the power-house.

The contracted cross section at the Long Sault Rapids some miles down the river frequently causes ice jams, but according to the records of the New York and Ontario Power Company only one jam at this point ever seriously affected tail-water at the Waddington power site. This occurred in the year 1905, and upon this occasion an attempt was made to swing a field of ice across the river to form an ice bridge. This field of ice broke away and choked the channel at the Long Sault to such an extent that the river was filled with ice for 13 miles. Upon this occasion, the tail-water at Waddington rose until the head was only four feet. Since this time it is said that the Federal authorities have had watchmen on the river for the express purpose of preventing the recurrence of such a condition, and there is probably no great danger of its happening again.

Gauge readings extending over a period of 20 years indicate that an average head of 10 feet can be depended upon at all stages of flow under present conditions. This head could be increased 2 feet or more by excavation in the tail race, so that there appears no reason to doubt that a head of at least 10 feet is always obtainable at this point.

The topographical conditions at the site of development are favorable for cheap construction, as the dam will be founded upon solid rock. Also the inlet of the Little River is almost at right angles to the course of the main stream, and as above mentioned the current of the main stream across the mouth of the inlet is 3 to 4 miles an hour. This condition would obviate to a large extent the possibility of any large quantity of frazil, anchor ice, or drift ice finding its way into the head-race of the development. The main difficulty to be anticipated will be the formation of thick ice in the forebay, owing to the necessarily low velocity. This disadvantage could be discounted, however, by a small annual expenditure at such season of the year as the trouble would manifest itself, as the ice would be cut out and floated over the sluiceways. As before mentioned the danger of the rocks or channel being blocked by frazil is not great, but the installation of a heating system along the racks would largely do away with trouble of this kind.

The scheme of development involves the installation of 42-500 kv.-a. units arranged in six groups of seven units each. The grouping of the units and the proposed scheme of control is such that the regulation should be nearly perfect, and the flexibility of the control is conducive to continuous service.

The projected development of 30,000 h.p. will necessitate the enlargement of the channel, but as this can be done to a large extent by dredging, such enlargement need not be completed at the outset, but would need simply to keep pace with the additional installation of generating capacity. The necessity of maintaining

the head at 10 feet will require a very low velocity in the head-race, and while this will involve the use of a large cross section it will be a great advantage in still further reducing the liability of frazil and anchor ice being drawn in from the main channel of the river.

The company claims to have all the necessary legal rights for development at Waddington settled by the authority of the United States Supreme Court and the intention is to acquire the whole of Ogden's Island and the riparian rights on the opposite side of the channel. The purchase of this property should make their titles unassailable, always providing of course that the titles will bear inspection. This is a matter for the Legal Department to take up if thought necessary.

The whole question under this head now turns upon whether or not the natural flow of the Little River under minimum conditions is sufficient to develop the 30,000 h.p. for which the company ultimately intend to instal generating capacity.

During last winter a detailed topographic survey was made of the channel of the Little River. This plan is now completed and is in the hands of Mr. John B. McRae of Ottawa, the company's engineer. The company's claim that the flow of the Little River is adequate for the projected development will require to be proved by the results of this survey.

Under ordinary conditions, a 10 foot head on the St. Lawrence is a dangerous proposition from the standpoint of continuous operation, but the topographical features of the site at Waddington are so unusually favorable that danger of service interruption exists to a much less degree at this point than at any other similar site on the river.

April 3rd, 1911.

REPORT NO. 16.

Goderich.

The natural source of power for Goderich and the neighboring municipalities is the Maitland River, which rises on the height the land between Lake Erie and the Georgian Bay and flows into Lake Huron. The watershed of this river is about 950 sq. miles in extent, and is largely drained and deforested. As a result the natural flow characteristics have been destroyed, and the watershed of the Maitland, in common with the watersheds of other rivers in the south western peninsula, has an uncontrolled run-off which produces heavy spring freshets and a correspondingly low discharge during the late summer and early autumn periods.

The abnormal flow characteristics of the Maitland River to a large extent discount its value as a source of power, in that the watershed is almost entirely lacking in natural storage basins. The country throughout the watershed is cleared and cultivated, so that such regulation by perennial storage as would be necessary to offset the effect of drainage and deforestation could only be established at prohibitive expense for land damages and dam construction.

The power possibilities of the Maitland River can therefore be discussed only on the basis of minimum flow, in conjunction with such advantage as can be derived from local pondage and night flow. In other words it must be considered as a combined 24 hr. and 10 hr. power proposition.

Flow data and gauge-height records are being collected at the present time, but these records are not yet extensive enough to assign any definite value for the minimum flow of the Maitland River, or to establish the duration of the minimum flow period. It will be reasonable to assume, however, that the minimum flow drops to 150 second-feet, and that the minimum flow period has a duration of two months.

The total drop of the Maitland River from head-waters to mouth is about 800 feet, but the characteristics of the watershed are such that no natural heads of any consequence exist, the gradient of the river being uniform and the velocity fairly high. In consequence power can only be developed by diversion, or by the creation of artificial heads, or by a combination of both these methods. This condition, in conjunction with the poor regulation of run-off, has a tendency to make development expensive, with a resulting comparatively high annual cost of power. These two conditions react upon each other in that the development of power in commercial quantities necessitates a high head on account of the small minimum flow, and the high head, in view of the conditions above noted, necessitates heavy expense for the construction of permanent works.

The best site available for development upon the Maitland River is at a location known as the Black Hole, about three miles up the river from Goderich. A head of 80 feet can be obtained here by means of an expensive dam and a diversion across the neck of an ox-bow bend in the river. An additional head of 10 feet can also be obtained by carrying a tail-race about 1,700 feet down the river from the location of the power-house.

In estimating the amount of power capable of being economically developed at this site it has been necessary to make two fundamental assumptions, as follows:—

- (1) That the minimum flow is 150 cubic feet per second.

(2) That the present average night load will not exceed 500 h.p.

The contemplated scheme of development involves the construction of a dam about 1,800 feet long across the river valley, having a maximum height of 85 ft. above bed-rock. This dam will create a pond about 700 acres in area, the back-water extending up the river to the Ben-Miller bridge. The intention is to construct an earth-fill dam with a concrete core-wall, and the topographical conditions are such that this fill can be placed at least expense by the hydraulic process.

Under a head of 80 ft., the assumed minimum flow of the river would produce 1,000 electrical h.p. on a continuous 24 hr. basis. Assuming as above, however, than an average amount of 500 h.p. only will be used between the hours of 6 p.m. and 7 a.m., there will be a surplus discharge of 73 second-feet available for night storage. The water thus accumulated when distributed over 10 hours, will augment the normal flow to the extent of 90 sec. ft., making 240 sec. ft. available for 10 hrs. This would produce 1,600 electrical h.p. for 10 hrs. under an 80 ft. head. The pond created by the proposed dam would supply the requisite amount of night storage with a negligible variation in head, and this leads to the consideration of the fact that the area of pondage available will permit the partial storage of local showers. This will be of great assistance in handling abnormal peaks and to a certain extent in helping the plant over extreme low-water periods.

It will be noted that the above estimates of capacity are based on an 80 foot head. This is on account of the fact that the utilization of any additional head will entail considerable expense in tail-race construction. An extra 10 feet of head will increase the capacity of the site about 12½ per cent. but at the outset the generating equipment can be installed to operate under 80 feet, and the additional head can be obtained subsequently when the load conditions are such as to require increased generating capacity.

It has been determined that the cost of continuous 24 hr. power as derived from the Maitland River is rather high, but in view of the fact that this river is capable of developing from 1,000 to 8,000 horse-power at 80 foot head under various conditions of flow a reasonably cheap source of auxiliary supply might effect a very great reduction in the average yearly cost of Maitland River power, by reason of the fact that an independent auxiliary would make it economically feasible to install capacity for the development of additional power at high stages of flow.

There exists in the Niagara High-tension system a source of auxiliary supply amply capable of making good for an indefinite period any shortage in the supply of Maitland River power, and the most important phase of the problem is to determine what the effect will be on the cost of power due to serving the Mitchell-Goderich district jointly or alternatively with Maitland and with Niagara power. The load requirements at the present time are such that the Maitland would probably serve as the source of continuous supply, with the Niagara system performing the function of an auxiliary, but the load requirements of a fully developed market in this district will probably reverse this condition, and the Maitland power will be used as an auxiliary mainly for the purpose of peak regulation.

To arrive at a solution of this important problem, it will primarily be necessary to collect data for the purpose of testing the two assumptions upon which the figures in this report are based. The principal requirements are as follows:—

1. To ascertain the flow characteristics of the Maitland River and the resulting power capacities at different seasons of the year.

2. To ascertain definitely the limitations of the watershed in the matter of artificial storage.

3. To ascertain the economic limit of installed capacity for the generation of power at the Black Hole.

4. To ascertain minutely the load requirements of the municipalities to be served, and also the load characteristics.

5. To determine the cost of delivered power from the Niagara system considered as a separate source of supply.

6. To determine the cost of delivered power from the Maitland system considered as a separate source of supply.

7. To determine the most practical and economical means of making two sources of supply jointly or alternatively available.

8. Finally, based on the above, to determine the resultant cost of power from the combined systems.

In view of the above it is impossible at the present time to submit definite figures, but as regards the Maitland development, an indication of the possibilities can be given by assuming that a plant having a generating capacity of 6,000 h.p. is installed at the Black Hole. From what is known at the present time, it would seem safe to estimate that a plant of 6,000 h.p. installed capacity, operating for one year under various conditions of flow, could deliver the equivalent of at least 3,500 h.p. continuous 24 hr. power. This would seem to indicate that considerable economic advantage is to be derived from the development and distribution of continuous and intermittent power from the Maitland River.

As before mentioned, the extent of this advantage cannot be definitely determined with the data now available and the function of this report is to give a reasonable view of possibilities.

From an engineering standpoint the scheme is quite feasible, and it would seem also to have great possibilities as a commercial proposition.

May 8th, 1911.

REPORT NO. 17.**Beaver River.**

The market possibilities of Owen Sound, Collingwood, Meaford and neighboring municipalities are such that their requirements will probably soon exceed the capacity of such local sources of hydro-electric supply as are available, and ultimately the Niagara Transmission System must be called upon to supply any additional demand for power. In the meantime, however, these municipalities should be supplied from a local source if one can be found which will adequately meet the present and immediate future demand for power.

Source of Local Supply.

The Severn, Saugeen and Beaver Rivers comprise what may reasonably be termed the local sources of supply for this district, the Severn being represented by the development at the Big Chute, and the Beaver River by a possible development at Eugenia Falls. Power from the Severn could not be economically supplied west of Collingwood and it is also probable that the Midland-Penetang district will ultimately require all the power which it can supply. The Saugeen River is the only source of local supply for the district which includes the towns of Paisley, Chesley, Port Elgin and Southampton, so that the Beaver River is the only source of supply which can be considered as applying directly to the Collingwood-Owen Sound district. The one development worth considering on the Beaver River is that at Eugenia Falls, and the function of this report is to indicate as fairly as possible, with the data available, the amount of power capable of development and the costs incidental thereto.

Watershed.

The portion of the watershed of the Beaver River which is tributary to Eugenia is about 74 sq. miles in extent, and is situated on the height of land between Lake Erie and Georgian Bay, at an elevation of about 1,800 feet above sea level. The greater portion of the watershed is in the Townships of Artemesia and Osprey in the County of Grey, and is generally cleared and under cultivation, but there is a considerable area of tamarack and cedar swamps. There are also a number of large springs, which would seem to indicate the existence of good ground storage, in addition to the natural surface storage in the swamps. These conditions are advantageous in that good ground storage and sheltered surface storage in the swamps tends to minimize evaporation, which in turn tends to produce a high-run-off factor. Such a condition might be reasonably expected to obtain in the case of the Beaver River watershed.

Precipitation.

There are no rain-fall records in existence which apply directly to the portion of the Beaver River watershed under consideration. The mean annual rain-fall, as measured at several of the nearer Georgian Bay and Lake Huron coast towns, varies between 34 and 38 inches. The mean annual rain-fall at Barrie is about 30 inches, and one year's record at Shelburne shows a rain fall of 32 inches. The Georgian Bay and Lake Huron towns lie about 1,200 feet below, and Shelburne lies 150 feet below the average elevation of the Beaver River watershed. In the first two instances, the difference in altitude would have some bearing on the volume and distribution of rain-fall, but the comparatively small difference in altitude in the case of Shelburne, and the fact that Shelburne is only 20 miles from the

centre of Beaver River watershed, would seem to justify an assumption that somewhat similar conditions would obtain within these limits. On this basis, therefore, the mean annual rain-fall on the height of land at Eugenia should be fully 30 inches, and the minimum probably falls but little below this amount.

Natural Flow Characteristics.

For the past year, ending June 30th, 1911, records have been kept of weir discharge at Eugenia Falls, head measurements having been made twice a day during this period. From the data thus obtained the discharge has been computed and plotted in the form of a curve, from which the following figures are derived:—

Mean Monthly Discharge:

1910.		
July	41.95	second feet.
August	34.89	"
September	28.49	"
October	31.61	"
November	44.10	"
December	35.12	"
1911.		
January	43.46	"
February	49.07	"
March	83.75	"
April	251.98	"
May	92.21	"
June	46.78	"
Mean Annual Discharge	65	second feet.
Minimum Discharge, Oct. 2, 1910	23.0	second-feet.
Maximum Discharge, Apr. 15, 1911	530.0	second-feet.

Based on the above figures, taking the area of 74 sq. miles and the minimum annual precipitation at 30 inches, the watershed would have the following characteristics:—

Run-off—40 per cent. of annual precipitation.

Minimum run-off per sq. mile of watershed—.32 second feet.

Mean run-off per sq. mile of watershed—.87 second feet.

Maximum run-off per sq. mile of watershed—7.2 second feet.

This curve also evidences two important facts:—

1. The mean discharge for the latter half of June, 1911, was 20 per cent. less than the mean discharge for the latter half of June, 1911.

2. There was no noticeably high water in the fall of 1910.

These two facts are intimately related in that the low stage of flow in the autumn of 1910, which was said to be much less than normal, indicates that the greater portion of the flow was drawn from ground storage. The replenishment of the ground storage would therefore occur during the spring flood of 1911, the natural result being a reduction of flood discharge, and a shortening of the flood period. This would account for the fact that the mean discharge for June, 1911, is less than the mean discharge for June, 1910, and it would justify the assumption that the spring flood of 1911 was smaller than usual and probably a minimum. Therefore, the conditions, as evidenced by the data at hand, would be such as to produce a minimum quantity of surplus flow available for storage purposes.

The curve indicates as well that the mean monthly flow exceeds the mean annual flow only during the months of March, April and May. If this is a normal condition it means that the utilization of the total run-off of the watershed will require storage reservoirs of sufficient capacity to impound the entire surplus run-off with one filling and consequently a greater cost for dam construction than would be the case if a fall filling could be counted on.

Power Capacity Without Storage.

There are two schemes of development possible at Eugenia, one involving the building of a dam and about 3,500 feet of pipe-line for an effective head of 400 feet. The other scheme would give an effective head of 450 feet and would require the building of a dam, 4,000 feet of canal or flume, and a 3,500 foot steel pipe-line. Both these schemes will be considered in estimating power capacity.

In estimating the power capacity under natural conditions of flow, it is fair to assume that such dam construction as is necessary for development will have sufficient impounding capacity to equalize daily fluctuations of flow at low stages, and also to provide storage at periods of light load when the total available flow is not required. This being the case, the natural capacity can be based on the mean monthly discharge both for 10 hr. and 24 hr. power.

Using the figures for mean monthly flow, as given in the preceding paragraph, the average monthly output of power at the turbine-shaft would be as follows:—

Month		Continuous 24 hr. power		Mixed 10 hr. and 24 hr. power	
		400 ft. Head	450 ft. Head	400 ft. Head	450 ft. Head
July,	1910.....	1,525 h.p.	1,720 h.p.	3,130 h.p.	3,600 h.p.
August,	“	1,270 “	1,430 “	2,545 “	2,905 “
September,	“	1,037 “	1,165 “	1,965 “	2,250 “
October,	“	1,150 “	1,295 “	2,220 “	3,580 “
November,	“	1,601 “	1,803 “	3,310 “	3,810 “
December,	“	1,280 “	1,438 “	2,545 “	2,950 “
January,	1911	1,580 “	1,778 “	3,275 “	3,770 “
February,	“	1,782 “	2,005 “	3,750 “	4,300 “
March,	“	3,050 “	3,430 “	.....	.....
April,	“	9,175 “	10,310 “	.....	.....
May,	“	3,350 “	3,770 “	.....	.....
June,	“	1,720 “	1,915 “	3,560 “	4,060 “

The figures in the above table indicate that on the basis of existing records of flow, the minimum amount of 24 hr. power would be 1,037 h.p., or 1,165 h.p. according to the head developed. The estimate of mixed 10 hr. and 24 hr. capacity is based on the assumption that the average night load for 13 hours will be 400 h.p. On this basis the minimum average commercial capacity of the plant would be 1,965 h.p., 10 hr. power for a 400 ft. head, and 2,250 h.p., 10 hr. power for a 450 ft. head, after allowing for an average night load of 400 h.p.

Storage.

The figures in paragraph 5 show that the mean discharge for the months of March, April and May is 142.6 second-feet, these being the months of high water flow. The mean discharge for the remaining 9 months is 39.4 second-feet. These figures considered in relation to the minimum mean monthly flow of 28.5 second-feet in September, indicate that the power capacity of the stream could be very largely augmented by artificial storage, and when costs are considered it will probably be found that the commercial success of the scheme will be measured principally by the extent to which the annual run-off of the watershed can be economically conserved by artificial means.

Assuming, as above, the existence of a suitable dam at the head-works, the minimum dependable flow, according to the records, is 28.5 second feet. The maximum benefit to be derived from storage would be the production of a continuous flow of 65 second-feet, which has been shown to be the mean annual discharge for the year ending June 30th, 1911.



"Eugenia Falls," Beaver River.



"Big Chute," Severn River.

The ultimate power capacity will, therefore, depend upon the continuous discharge which will be available when the storage has been developed to the economic limit, and will lie between the values given above, being nearer one or the other according as the topographical conditions and construction facilities throughout the watershed are favorable or unfavorable.

Very little information is at hand at the present time concerning the topography of the watershed above Eugenia Falls, and it will require a careful examination before any reliable estimate of storage cost or capacity can be arrived at.

Power Capacity From Storage.

It has been shown that to improve the flow by storage the spring surplus will probably have to be depended upon, as the records indicate that a fall filling of the reservoirs cannot be regarded as a certainty. If the maximum benefit to be derived from storage is considered to be that which will provide a continuous discharge of 65 second-feet then reservoirs will be required which have sufficient capacity to maintain this discharge with one filling in the spring. To accomplish this would require 14,400 acre feet to reservoir capacity.

To obtain this volume of storage in a watershed deficient in lake area, and only 74 sq. miles in extent, would probably entail a greater capital investment than the benefits derived would justify, but one-half at least of this capacity should be obtainable, and two-thirds may be regarded as a reasonable possibility. The table below shows what may be anticipated in the matter of average power capacity under the various conditions:—

Storage Capacity.	Continuous 24 hr. Power.		Mixed 10 hr. and 24 hr. Power.	
	400 ft. Head.	450 ft. Head.	400 ft. Head.	450 ft. Head.
14,400 acre feet	2,360 h.p.	2,660 h.p.	4,930 h.p.	5,600 h.p.
9,600 "	1,820 "	2,050 "	3,580 "	4,120 "
7,200 "	1,455 "	1,635 "	2,710 "	3,140 "

The above figures for 10 hr. power are based on the assumption that the *average* night load for 13 hours will not exceed 600 h.p. The pondage required for night storage under maximum conditions would be about 120 acre feet, and the minimum required would be about 65 acre feet, which the head-works reservoir should be capable of supplying.

The cost of power resulting from the development of storage cannot be determined with any degree of certainty at the present time, owing to the fact above mentioned that there is not sufficient data available with reference to the characteristics of the watershed, but unless abnormally bad conditions obtain, the unit cost of developed power should be reduced as the power capacity is augmented.

It remains, therefore, to determine definitely the economic storage capacity of the watershed, and to ascertain by a detailed examination of the site, and afterwards by comparative estimates, whether the greater expense, if any, involved in developing the greater head will be compensated for by the increased power capacity, considered in relation to the existing market for power and the possibility of its future expansion.

July 14th, 1911.

REPORT NO. 18.

Orillia.

Orillia's municipal power scheme was inaugurated in 1898, when steps were taken to acquire control of the power site at Ragged Rapids on the Severn River, about 20 miles from the Town. Actual construction was begun in 1899, and in 1902 continuous power was being delivered.

From that date up to the present time the history of the plant's operation has been marred by a series of accidents, resulting in serious interruption of service and involving the town in a much greater amount of capital expenditure than the scheme should reasonably carry. The location of the generating plant was the primary cause of the trouble, but a large part of it must be charged to faulty construction and design. The fault with the location is that the gorge in which the plant is located does not allow sufficient room for regulating flood water and properly passing water through the wheels. The restricted cross-section in the gorge was also doubtless responsible to a large extent for the faulty construction of the first dam and the power-house, owing to the difficulty and expense of unwatering, and the subsequent undermining of the outer power-house foundation wall is attributable to the same cause.

It is not necessary to deal here with the system in detail, this being covered by the reports of the Town Engineer under date March 6th, 1911, and March 31st, 1911, respectively. It has been ascertained, however, that the criticisms in these reports have not been exaggerated, and that the one first-class asset at present held by the town is the dam at Ragged Rapids. While it is without doubt improperly located, it is well designed and constructed and capable of performing its functions.

The extent of the present market and the amount of power business actually in sight indicates that by next fall the system, operating at full rated capacity in its present condition, will be quite unable to handle the load, the shortage being conservatively estimated at 900 h.p. The main problem under consideration is, therefore, to ascertain the best means of augmenting the supply of delivered and available power. The supply of delivered power could be augmented by increasing generating capacity and by improving power-factor. The supply of available power could be augmented by the means above specified, and also by metering the domestic service and commercial light.

The conditions in Orillia are such that the installation of meters and the correction of power-factor by means of a synchronous condenser, might reasonably be expected to relieve the situation temporarily. It is to be noted, however, that this method of making good the shortage presupposes a reliable and continuous source of supply. In the case of Orillia, this, unfortunately, does not exist, as the above mentioned reports of the Town Engineer show conclusively. The question of augmented power supply, therefore, resolves itself primarily into an investigation as to the best means of making that supply adequate, efficient and continuous.

The layout at Ragged Rapids is such that additional capacity cannot be efficiently installed without partially shutting down and completely remodelling the plant. This is partly on account of the weakness of the floor structure and the foundation walls, but the fundamental defect is in the design of the tail-race. At present the three wheels discharge into a tail-race of 60 sq. feet cross-section running parallel to the line of the wheels. The draft-tube of No. 1 unit is placed at the lower end of the tail-race, and leaves only about 30 sq. ft. cross-section for

the discharge of No. 2 and No. 3 units. This gives rise to a choking effect which reduces the effective head on No. 2 and No. 3 units from 2 to 4 ft. at full load.

If another wheel were installed to discharge in this tail-race, or if the capacity of the present wheels were increased, the effective head on No. 2 and No. 3 units would be reduced to such an extent as to probably affect their regulation. To install additional capacity in the present plant, a reinforced concrete floor should be substituted for the present wooden one, and the whole foundation plan of the power-house should be altered so that each unit could discharge into a separate tail-race at right-angles to the course of the river. If this method of construction had been followed in the first place, the installed capacity could have been added to from time to time without impairing the efficiency of the units already installed, and the trouble due to the undermining of the foundation walls would have been practically eliminated.

Below the power-house is a series of rapids having a fall of about 10 feet at low water in a distance of 750 feet. At the foot of these rapids is the location which should have been used in the beginning as the site of the dam and power-house. Assuming a 10 ft. drop from the mouth of the present tail-race, and a 4 ft. loss of head in the tail-race itself, in the event of another unit being installed, it is evident that a plant at the foot of the rapids would have an effective advantage of 14 feet additional head over the plant in its present location. This would give the lower plant 40 per cent. more hydraulic capacity with the same amount of water.

The general scheme of development proposed by the town Engineer is the best that could be derived under the circumstances, as it would be folly to abandon the dam as present constructed. In view of this, the flume construction as proposed is the best method of getting water to the wheels. It is to be noted also that the design of the Town Engineer embraces the separate tail-race construction above referred to.

As regards generation, therefore, the point at issue is whether it is advisable to alter and enlarge the present plant, or to construct an entirely new plant on the lower site. From an engineering standpoint, everything is in favor of building a new plant. A financial view of the situation can only be obtained by making comparative estimates.

The annual statement for 1910 shows a revenue of \$36,788.34, including a lump sum of \$3,950 credited to the power-system for street lighting and water-works pumping.

The annual charges are composed of \$18,209.47 in interest charges and debenture payments, and \$16,764.48 in operating expenses. The operating expenses include about \$8,000 for wages, \$7,000 for maintenance and supplies and \$3,500 for expenses in connection with the Dolittle suit. These maintenance charges are more than double those for 1907-8 and 1909, so that for a new and remodelled system \$5,000 should be ample to allow under this head. The wages account could probably be cut \$1,000 under the same conditions, and the \$3,500 legal expenses could be eliminated entirely. This would mean a total reduction of \$6,500, which would make the total annual charges for 1910 about \$28,500. Under these conditions the revenue for 1910 would, therefore, have produced a surplus of \$8,300. Assuming a 5 per cent. interest charge, 1.8 per cent. for a 30 year sinking fund, this surplus would pay the fixed charges on \$122,000 additional capital investment.

This amount of money would probably cover the cost of remodelling the present system and of such additional generating capacity as is necessary, but it would not cover the cost of an entirely new power installation.

In view of this it would be advisable to have an estimate made based on an alternative scheme covering:—

- (1) Remodelling of present power-house and tail-race.
- (2) Replacement of one or both of the older units by direct-connected units of larger capacity.
- (3) Installation of adequate transforming equipment.
- (4) Repairs to transmission line.
- (5) Remodelling of substation and distribution system.

This estimate might also include the cost of deepening and widening the channel below the power-house, in order to take advantage of as much of the additional head as is practicable. It would also be necessary to allow for the cost of an additional steam auxiliary in Orillia to carry the load while different portions of the plant at Ragged Rapids were out of commission.

While this scheme is feasible and should give satisfactory results, its main advantage lies in the fact that it appears to be within the borrowing power of the system on the basis of its present revenue, but if the more extensive scheme can be financed, it is unquestionably the best and will give better results in the end. The problem to be faced is the absolute necessity of ensuring the safety of the supply of generated power, and the choice lies between a scheme which will impose a heavy present obligation with a maximum of future benefits, and one which will permanently curtail the hydraulic capacity of the site, but will involve the town less financially.

The gain in hydraulic capacity and the general increase in efficiency under the larger scheme must, therefore, be considered in connection with the additional expense, and it is worth while considering if the industrial future of the Town would not in itself justify the construction of a new plant to utilize the hydraulic capacity of the site to the fullest extent. In the meantime, no definite choice should be made between the two schemes until the respective costs have been accurately determined from the best available data.

The correction of power-factor and the installation of meters are two questions which the town will require to consider as soon as the safety and continuity of the power supply is assured. The synchronous motor for power factor correction can be installed when the pumping station is rebuilt. When connected to a turbine pump it will do useful mechanical work as well as performing its function as a power-factor rectifier. The question of installing meters has been taken up in the report of the Town Engineer, and when the main issue has been decided, this phase of the problem will require careful consideration. It can be shown without doubt in the case of Orillia, as in other municipalities, that the meter system of measurement for light and a combined flat rate and meter rate for power is beneficial both from the consumer's standpoint and the standpoint of revenue.

A careful examination of the Auditor's Reports from 1899 to 1910 has demonstrated the utter futility of attempting to gain from them any reasonably accurate information as to the proper distribution of charges, or the present value of the physical assets. There appears to be no possibility of ascertaining from existing records what the different portions of the plant cost originally, or what money was spent on them subsequently. Items totalling some thousands of dollars have been entered in the Expense Account under the general head of "Supplies."

Small incidental repairs on wheels and generators have been charged to Capital Account, while another item amounting to \$650 for new gates has been charged to Expense.

In 1902, \$11,000 for waterworks pumps and motors was charged to Power Construction. It is difficult to see why this was not charged to the waterworks. In the 1910 financial statement, the list of permanent assets includes \$300,000 as the value of the power system, which is certainly not the true valuation of the system as it stands to-day. A proper system of accounting is a prime necessity for the successful and intelligent management of the Town's power business, and when the generating and distributing plant has been renovated and enlarged such a system should be devised and put in operation. In this connection the first step to be taken will be to value the improved system and charge the difference between this valuation and the total debenture debt to depreciation and profit and loss.

In conclusion it is recommended that the following programme be carried out in order to put the system on a safe operating and commercial basis, the items being listed in the order of their importance:—

- (1) The rebuilding or remodelling of the generating plant.
- (2) The repair of the transmission line.
- (3) The remodelling of the sub-station and distributing system.
- (4) The establishment of a proper accounting system.
- (5) The installation of meters.
- (6) Power-factor correction.

It may be mentioned that the Town's \$16.00 flat rate for power is misleading in that it takes no account of power-factor. For motors of 10 h.p. or over the charge is based on the volt-amperes taken under maximum load conditions, so that the customer is paying \$16 per h.p. per year for apparent power and not for real power. The power-factor of induction motors of such sizes as are used in Orillia varies from 50 per cent. for small motors to 80 per cent. for large motors. A 50 per cent. power-factor would make the cost of real power \$32 and 80 per cent. power-factor would make the cost of real power \$20. This variation of power-factor has the effect of a sliding scale of prices, making the price probably as high as \$35 for a small user who has a motor which has spare capacity over maximum load demand, and \$20 for a large user whose motor is fully loaded at maximum demand. These prices are not unreasonable in view of the heavy burden of fixed charges which the plant has to carry, but the charge should be made on a proper basis.

With the plant in its present physical condition and the accounting system so inadequate, it is hardly worth while to discuss rates, but when the system is properly renovated and reorganized, the question of rates should have immediate consideration.

May 6th, 1911.

REPORT NO. 19.

Englehart.

Sources of Power.

The nearest available source of power for the Municipality of Englehart is the Blanche or White River, one of the upper branches of which flows within a short distance of the town-site.

Flow Characteristics.

As shown on existing maps, the catchment basin above Englehart is about 230 sq. miles in area, but further than this no great quantity of information is available upon which to base a fair estimate of power possibilities. Messrs. Sutcliffe and Neelands of New Liskeard report 125 second-feet as the result of a gauging November, 1908. If this is assumed as representing the minimum flow, the late winter flow could not be safely estimated at more than 100 second-feet. On this assumption, therefore, the White River at Englehart would produce about 8.5 continuous 24 hr. electrical horse-power per foot of head. The above minimum flow from the above watershed would require a minimum run-off of about .45 second-feet per square mile. For the smaller Laurentian rivers to the south this co-efficient would be too large, but in view of the greater possibilities for ground storage in the clay belt, its acceptance in this case is possibly justifiable.

Available Sites and Capacity.

The White River, between Lot 12, Con. III. of Evanturel, and Lot 3, Con. III. of Dack, has a fall of approximately 134 feet, this head being mainly concentrated in various chutes and falls, the most important being at High Falls on Lot 12, Con. III. of Evanturel, about $2\frac{1}{2}$ miles from Englehart.

By placing a dam at the crest of High Falls an average head of 65 feet could be made available, and a simple scheme of development would produce 550 h.p. continuous 24 hr. power at the switchboard under assumed low water conditions.

Market.

The population of Englehart is, at present, about 663, and within the Corporation limits there are 110 houses, 14 stores, 5 churches, 2 hotels, 1 school, 2 halls, 1 pool-room and a gaol. There is also the T. & N. O. Station, and being a divisional point, there is also a round-house, with small shops in connection. The above embraces the market now definitely in sight, which may be fairly summarized as follows:—

Incandescent Lighting	40 h.p.
Arc and Street Lighting	30 h.p.
T. & N. O. Ry.	50 h.p.
Total present load	120 h.p.

As to future market prospects, it may be mentioned that the T. & N. O. contemplates moving a portion of the North Bay shops to Englehart, in which event they would require about 90 h.p.

There is also talk of a grist-mill being established which could probably require 25 h.p. The prospective market would therefore be:—

Lighting load, as above	70 h.p.
T. & N. O. Ry.	90 h.p.
Grist-Mill	25 h.p.
Total prospective load	185 h.p.

There is also a possibility of selling 40 h.p. to saw-mills in the vicinity, and 30 h.p. could possibly be used by the Municipality in the event of a waterworks system being installed. This added to the above would make a possible future load of 245 h.p.

Scheme of Development.

In the event of development, the Municipality's most important customer would be the T. & N. O. Ry., and the characteristics of this load are such as to require continuous and uninterrupted service. Any scheme of development, therefore, should be laid out primarily with this fact in view. In the matter of transmission, the distance is so short and the voltage (2,200) so low, that a single power circuit would seem adequate for present or immediate future service requirements. Interruptions in transmission service are largely due to weather conditions, which can be anticipated and to a large extent guarded against on such a short line, so that a properly constructed single circuit line could in this case be depended upon to give reasonably continuous service. This condition does not obtain as regards the generating equipment. The site is so remote from the factories that an accident to a turbine or generator might result in its being out of commission for weeks. For this reason alone it would be dangerous and not at all advisable to concentrate the generating capacity in one unit.

The minimum 24 hr. capacity of the site has been estimated above at 550 h.p. It would be safe, therefore, to install 600 h.p. capacity for full development. Keeping in view the necessity of installing spare generating capacity, the requirements would be met most economically by a preliminary installation of two units of 150 h.p. each. As one of these units could carry the total prospective load within the limits of its overload capacity, continuous service would thereby be practically assured. When the market developed to such an extent as to require the continuous service of both units, an extra unit could be installed, having a capacity of either 150 h.p. or 300 h.p. as conditions required. This appears to be the best means of insuring continuous service with a minimum of annual cost. The ultimate installation will also gain in flexibility by making it possible to operate the wheels at or near the gate-opening of maximum efficiency.

Estimate No. 1 covers the cost of a first class wooden dam with eight sluice openings, a canal for full capacity with concrete head-gates and head-block, a steel penstock, a concrete power-house, 2-150 h.p. hydro-electric units with the necessary switching and lightning arrester equipment, and a double circuit pole line to Englehart, with single circuit erected.

Estimate No. 2 includes all items of estimate No. 1. and in addition the cost of another penstock, a 300 h.p. hydro-electric unit, extra switching equipment, and a duplicate power circuit to Englehart.

The annual charges in each estimate include interest and sinking-fund charges, maintenance and depreciation, operation, administration and sundries. The average cost of power covers the annual cost of same delivered at line pressure (2,200 volts) in Englehart.

The cost of low voltage distribution has not been included in this estimate, as it is not a fixed item of cost, and installation simply keeps pace with the demand for service. The prospective demand (185) could, however, be distributed for \$4.00 per h.p. per year and this price would drop to \$2.00 or \$1.50 per h.p. per year as the demand approached the hydraulic capacity of the site. This price is, of course, in addition to the annual price of power as quoted in the attached estimates.

Other Sources of Power.

At Charlton, about 7½ miles from Englehart, a 20 foot head has been developed on the south branch of the Blanche River. The plant is owned by K. Farah of New Liskeard and recently he has submitted a draft contract to the Corporation of Englehart covering the supply of light and power. The outstanding features of this contract are:—

- (1) The franchise is to be an exclusive one.
- (2) The rates set forth in the contract must continue in force for 10 years before any readjustment can be effected.
- (3) It is stipulated that the development rights at High Falls, now vested in the Municipality, shall be transferred to K. Farah, he to develop the same at any time or in any way he sees fit.
- (4) The contract imposes a six hour time restriction for waterworks pumping, except in case of fire.

The rates quoted are as follows:—

Commercial and House Lighting:—11 cents per kw.-hr., and a discount of 1 cent per kilowatt for “prompt cash payment.” Meter rental 25c. per month, up to 5-16 c.p. lights and 1c. per light per month for each meter over 25 light capacity.

Power:—Standby charges, \$13 per h.p. per year. Maximum differential, 3c. per kw.-hr. under 25 h.p. Minimum differential, 1c. per kw.-hr. for over 500 h.p.

Street Lighting:—\$55.00 per annum for 1,200 c.p. arcs, and \$14.50 per annum for 32 c.p. incandescents. These prices are to be paid during the next 10 years and “all subsequent terms.”

11 cents per kw.-hr., and a discount of 1 cent per kilowatt for “prompt cash payment.” Meter rental 25c. per month, up to 5-16 c.p. lights and 1c. per light per month for each meter over 25 light capacity.

Standby charges, \$13 per h.p. per year. Maximum differential, 3c per kw.-hr. under 25 h.p. Minimum differential, 1c per kw.-hr. for over 500 h.p.

Under the above power schedule a customer using 25 h.p. or under would pay \$19 per h.p. per year for 24 hr. power on a 50 per cent. load factor, or \$51 per h.p. per year for 10 hr. power on a 50 per cent. load factor. At the present time there seems no possibility of any one power customer in Englehart using more than 100 h.p. The price for 100 h.p., calculated as per schedule on the above basis would be \$45.50 per h.p. for 24 hr. power, and \$31.60 per h.p. for 10 hr. power. On a 50 per cent load-factor basis, this is the very lowest price a power customer in Englehart could hope to obtain under the Farah contract. It should be noted also, that when customers for 100 h.p. are available, the total amount of power sold for all purposes would, without doubt, exceed 300 h.p., in which event, 2,200 volt power could be delivered from High Falls, for an average price of \$24 per h.p. per year for 24 hr. power. The average price delivered to the customer should not in this case exceed \$27 per h.p. per year.

In conclusion it may be said as regards this contract, that the schedules throughout are very high, but apart from the question of price, the contract conditions, as itemized above, are such that a supply of power so obtained would be dear, even if it were supplied at cost.

Estimate No. 1.

Permanent works for full capacity and 300 h.p. installed.

Capital Cost:

Dam, Power-House and Permanent Works	\$8,360 00
Hydraulic Equipment	5,490 00
Electrical Equipment	7,500 00
Transmission Line	2,785 00
Excavation and Unwatering	5,900 00
Right-of-Way	1,000 00
Roofing, Glazing, etc.	465 00

\$31,500 00

Engineering and Contingencies, 10%	3,150 00
Interest during Construction, 3%	1,038 00

Total Capital Cost \$35,700 00

Annual Charges:

Interest, 4½% on \$35,700.00	\$1,606 00
Sinking Fund, 1.8% on \$35,700.00	643 00
Maintenance and Depreciation	1,272 00
Operation and Administration	2,000 00
Sundry Expenses	300 00

Total Annual Charges \$5,821 00

Average cost of 2,200 volt power, on basis of 185 h.p. 24-hour
power delivered \$31 50

Estimate No. 2.

Full capacity 600 h.p. installed.

Capital Cost:

Preliminary installation	\$31,500 00
Additional Hyld. Equipment	4,490 00
Additional Elect. Equipment	5,500 00
Additional Transmission	1,785 00

\$43,275 00

Engineering and Contingencies, 10%	4,328 00
Interest during construction, 3%	1,298 00

Total Capital Cost \$48,900 00

Annual Charges:

Interest on 4½% on \$48,900.00	\$2,200 00
Sinking Fund, 1.8% on \$48,900.00	880 00
Maintenance and Depreciation	1,868 00
Operation and Administration	2,000 00
Sundry Expenses	300 00

Total Annual Charges \$7,248 00

Average cost of 2,200-volt power, on basis of 300-h.p. 24-hour
power delivered \$24 10

May 20th, 1911.

REPORT NO. 20.

Department of Agriculture.

In March 1st, an Engineer of the Commission was sent up to the Experimental Farm, at Monteith, to look into the possibility of developing a small water-power on the Driftwood River for the use of the farm.

It was found that within one-quarter of a mile or so from the farm buildings it would be possible to develop a 15 foot head. The discharge measured at the time of the Engineer's visit was about 40 cubic feet per second. This measurement, being taken in March, probably at the period of minimum flow, can be assumed as indicating the minimum power capacity of the stream. Under 15 ft. head this amount of flow will develop about 55 continuous 24 h.p. at the wheel. Although not at the present time acquainted with the character of the load to be carried, it is assumed that a 10 hr. service will probably cover necessary requirements. Under this condition it would be reasonable to install capacity for the development of 75 h.p. This, with a wooden dam and power house would probably cost about \$9,000.00. A fairly conservative estimate of annual charges would be \$1,800.00, which would make the average price for 75 h.p. at the switchboard about \$25.00 on a 10 hour basis.

The above will give an idea of the possibilities which will enable the department to judge whether or not it is advisable to take definite steps towards development.

In the event of a decision being made to develop this site additional data will require to be obtained and a more detailed investigation made of the proposition.

May 12th, 1911.

REPORT NO. 21.**Brampton.**

Owing to the lack of hydraulic data in connection with the Credit River, and the fact that no load records have been kept, there was no means of accurately determining the capabilities of the site from a hydraulic standpoint. From the attendants at the plant it was learned that the day load would average about 75 amp., and the night load about 15 amp., during the low water season. Assuming that these loads obtained for 13 hours and 11 hours, respectively, the total water consumption during 24 hours, assuming 70 per cent. average over all efficiency for the plant, would be about 5,675,000 cubic feet. This is equivalent to a uniform flow of 66 cubic feet a second, or a minimum 24 hour capacity of 102 h.p. for 19.5 feet, which is said to be the head obtainable at that point. The fore-bay has an area of about 35 acres, giving a capacity of about 1,530,000 cubic feet per foot draft, which is ample for night storage required for the loads assumed above. From what is known of the flow characteristics of the Credit River, 66 second-feet is a high figure to assign for the minimum flow.

In considering the value of the water power to the Town of Brampton, it should be determined whether or not the Town would have entertained the idea of developing a power of 100 h.p., 24 hour power at a probable cost of \$200.00 per h.p. It is very doubtful if such a proposition would have been entertained.

In addition to this, the plant as installed is not a first-class piece of construction. The down stream face of the over-flow dam is of timber which will shortly require renewal, and the wheels are set in wooden flumes, the power being transmitted to the generator by means of a jack-shaft and belt.

The transmission line, which is four miles in length, operates at generator voltage of 2,200 volts, and the drop at full load is said to be about 360 volts, so that it would not be possible to operate this plant as a peak proposition in conjunction with the Niagara System until considerable money has been spent on it.

In view of the above facts it does not appear that the Town of Brampton is justified in paying anything for a water-power which they probably would not have developed had it been offered to them in its natural state, or at any rate if they had done so, they would not have adopted the present scheme of development.

It appears, therefore, that any price which is agreed upon as fair should not include anything for the power site, and should be based solely on the present value of the installed plant and system, this value being in turn reduced by the elimination of any items which are not of value to, or cannot be utilized by, the Town.

May 31st, 1911.

REPORT NO. 22.

Huntsville.

Under date of September 13th, 1909, a report was forwarded to the Municipality of Huntsville, dealing with the question of obtaining a supply of Hydr-Electric energy for the municipality. The power possibility of the Muskoka River watershed was fully discussed in this report, and "The Portage" was recommended as best suited for the Town's requirements. Certain difficulties in connection with the navigation interests and the diversion of water were mentioned as reasons for not considering this scheme of development possible, and failing this, High Falls on the north branch of the Muskoka River was recommended as the best source of power. Nothing has since occurred which would justify any alteration in the recommendations as set forth in this report.

The most important development locations in the Muskoka River watershed are listed herewith, as follows:—

Location.	E.H.P. Capacity.	Distance from Bracebridge.	Distance from Huntsville.
South Falls	2,700	3 miles	29 miles
Bracebridge Falls	1,100	.....	.....
Wilson's Falls	930	2 miles	.....
High Falls.....	1,000	5 "	21 miles

Of the above location Bracebridge Falls and Wilson's Falls have been developed to full capacity by the Town of Bracebridge, 2200 volt, 2 phase equipment being installed in both plants. South Falls has been developed by the Town of Gravenhurst to the extent of 600 h.p., operating at 6,600 volt, 3 phase. High Falls is at present undeveloped.

As regards Huntsville, it will be seen from the above that High Falls and South Falls are the only two locations where power can be obtained by development, as Bracebridge has the other two locations developed to full capacity. It will also be seen from the above that High Falls is about 8 miles nearer to Huntsville than South Falls, which would make a material difference in transmission costs.

The market at present obtainable in Huntsville is said to be in the neighborhood of 850 h.p. The bulk of this power would be used in the tannery of the Anglo-American Leather Company, which, according to the manager, would require 600 h.p., 24 hour power. This tannery was built in Huntsville at the time when hemlock bark was required for tanning purposes. The town of Huntsville was, at that time, in the centre of the hemlock district. At the present time, however, a special liquor is used in tanning, and hemlock bark is no longer required, and it is mainly by reason of the fact that the Company has large and substantial concrete buildings and an up-to-date plant installed, that they are justified in remaining in the Town. This is the condition at present, but it will be necessary in the future to obtain cheap power if this industry is to be retained. It will be seen,

therefore, that the town needs cheap power, not so much to attract new industries, but to hold the ones already located there. This being the case, the first requirement is to locate a site for development which could be developed nearly to full capacity, thus obtaining a minimum annual cost for generation. The estimated minimum capacity at High Falls being 1000 h.p., it is evident that the requirements of the town of Huntsville will require about 85 per cent. of its capacity, so that the condition of a minimum annual cost for generated power would here obtain. To this would be added the additional advantage of a shorter transmission distance than from any other site having the necessary minimum capacity.

If the market in this district ever reaches, say 80 per cent. of the aggregate capacity of the power sites above mentioned, the proper course would seem to be to link them together in such a way as to form a unified system. Until such time as the market demand reaches this stage, however, it would seem quite sufficient to develop High Falls separately for the requirements of Huntsville, to leave Wilson's Falls and Bracebridge Falls connected separately to the Bracebridge load as at present, and to leave South Falls separately connected to the Gravenhurst load as at present, and to allow Bracebridge to procure such additional power as it may require by increasing the development at South Falls, jointly with the Town of Gravenhurst. In the event of the load at Huntsville at any future time exceeding the capacity of High Falls, two alternatives are open in the matter of securing additional power. First, by extending the High Falls-Huntsville transmission line to South Falls, or second, by developing one or more of the smaller powers which are located between High Falls and Huntsville, within one or two miles of the transmission line. The possibility of developing these auxiliary powers has been recently investigated, and it has been ascertained that there is one location on the north branch above High Falls where it would be feasible to obtain a head of 30 feet.

An approximate estimate indicates that a generating plant of 1200 h.p. installed capacity could be built at High Falls for \$65,000. Step-up and step-down transformation equipment at High Falls and Huntsville, respectively, could be installed for \$19,600. A transmission line from High Falls to Huntsville could be built for \$51,600. The total annual charges for generation, including interest and sinking fund, power rental, operation and administration, renewals and repairs and miscellaneous expenses would be \$8,500. The annual cost per h.p. would, therefore, be \$8.50, on the basis of the minimum capacity of the site, or \$10.00 on the basis of 850 h.p. sold in Huntsville. The annual charge on transformation, eliminating the sinking fund charge for five years, would be \$1,370, making the annual charge per h.p. \$1.37 on the basis of the minimum capacity of the site, or \$1.62 on the basis of 850 h.p. sold in Huntsville. The annual charges on transmission, eliminating the sinking fund charge for the first five years, would be \$4,450, making the annual cost of power \$4.45 on the basis of the minimum capacity of the site, or \$5.25 on the basis of 850 h.p. sold in Huntsville. The total cost of power delivered to the low tension busbars in Huntsville would, therefore, be covered by the above items, summarized as follows:—

	1,000-h.p. Capacity.	850-h.p. Sold.
Generation	\$8 50	\$10 00
Transformation	1 37	1 62
Transmission	4 45	5 25
Total Annual Cost	\$14 32	\$16 87

The total annual charges after five years would be as follows, after adding the annual charges due to a 25 year sinking fund on transmission and transformation.

Generation	\$8,500 00
Transformation	1,840 00
Transmission	5,690 00
<hr/>	
Total Annual Charges	\$16,030 00

Assuming that, at the end of the five-year period, 1,000 h.p. would be sold in Huntsville, the average cost of 24 hour power delivered at the low tension busbars will be \$16.03.

In the above estimates the depreciation charge has been eliminated, but renewals and repairs have been estimated at 3 per cent. on capital cost for transmission and



“High Falls,” North Branch, Muskoka River.

transformation, and 2 per cent. on capital cost for generation. These percentages are far in excess of what would occur in actual practice under ordinary conditions of operation. The annual charges also include operation, administration and generation and step-up transformation, together with transmission line patrol.

In the matter of local distribution it will be necessary to adapt the present lines throughout the Town for 3-phase, 60 cycle power. The information obtained with regard to the Town’s present system indicates that a safe estimate for a new pole line, built from the plant along Main Street to the swing-bridge and additional copper, insulators, cross-arms, and new transformers erected throughout the Town would be \$10,000. This sum includes the cost of building a line and installing transformers for the tannery, and also the cost of a new motor-driven turbine pump. The annual charges for distribution would be \$2,800, which sum includes \$1,500 assumed as the portion of last year’s wage account chargeable to electric service. The

Town could, therefore, deliver 850 h.p. of light and industrial power to the customer from High Falls, for a total capital investment of \$75,000 and a total annual charge of \$17,120 for the first five years of operation.

Although the discussion of rates is not properly a function of this report, it might be noted that the above figures, considered in connection with the 1910 statement of the Town's electric light system, indicate that if 700 h.p. of industrial load (including pump) can be connected up and sold for \$20.00 per h.p. per annum, the following revenue would be available to the Town:—

700 h.p., at \$20.00 per h.p.	\$14,000 00
Revenue for Electric Light, 1910	8,440 00
Total Revenue	\$22,440 00

Against this would be a total annual charge as follows:—

Total Annual Charge on new System	\$17,120 00
Annual Charge on Debentures still outstanding against present Electric Plant (say)	2,000 00
Grand Total, Annual Charge	\$19,120 00
Revenue as above	22,440 00
Net Surplus	\$3,320 00

It seems, therefore, that if the town can realize \$14,000 a year from the sale of industrial power, it will also be able to make a reduction in the present lighting rates.

As regards the power capacity of the North Branch of the Muskoka River, it may be mentioned that recently the flow has fallen to about half what has been herein estimated upon. This extreme low water is due largely to the fact that the dam at Port Sydney is being repaired, and it is certain that a well designed dam at Port Sydney, if properly operated, would produce much better flow conditions in the north branch than have existed heretofore. All things considered, there seems no reason to doubt that if the natural storage facilities are properly developed, the run-off from the watershed above Mary Lake will produce from 900 to 1000 h.p. continuous power at High Falls.

September 1st, 1911.

REPORT NO. 23.

Almonte.

The Mississippi River divides in the Town of Almonte into two channels, locally known as the "North" and "South Branch." The South Branch consists of a rocky gorge, through which the stream flows for some 800 feet, having a natural fall of about 51 feet in this distance at low stages of flow. On the North Branch this fall occurs in a distance of about 1800 feet.

Owing to the steep gradient of the stream and the favorable rock formation, the South Branch offered the best natural facilities for power development, but the North Branch carried the bulk of the flow, especially at low stages. Having availed themselves of the natural advantages afforded by the South Branch in the matter of development, the original mill owners subsequently found themselves obliged to divert water from the North Branch in order to supply the water necessary during low stages of flow. This was done by building a low dam, now known as the Chancery Dam, across the head of the North Branch, a few feet west of the present line of Main Street in the Town of Almonte. As originally built, this dam was a crude structure of logs and slabs which was partially destroyed every year by the spring freshet and was renewed and repaired every year when the owners operating on the South Branch ran short of water. The original dam was built some time previous to the year 1824, and was periodically repaired and renewed as above described, until the year 1857. In 1857 the dam was rebuilt in a more permanent manner. The logs and plank were pinned and bolted to bed-rock and the planks were laid close together, making a fairly tight structure.

Up to this date the development of power had been confined exclusively to the South Branch, and one of the industries operating was the woolen mill of Rosamond and Co. Several years after this date, however, they sold out to one Andrew Elliott, and about the year 1866, the Rosamonds started to build a new woolen mill on the North Branch. They built a dam a short distance below the Chancery Dam, and installed auxiliary steam, the plant being in operation in the Fall of 1867.

In the Fall of 1868, when the owners on the South Branch endeavored to put some repairs on the Chancery Dam, the Rosamonds interfered and destroyed a portion of the dam. The resulting dispute ended in a legal action being taken in the name of W. Forgie *vs.* Bennett and Wm. Rosamond. Judgment was rendered in 1871 to the effect that the plaintiff (Forgie) was entitled to maintain the dam in the same condition as it was when repaired in 1857, and an injunction was issued to prevent the Rosamonds from interfering with it. This judgment, therefore, established the right of the parties interested to permanently maintain a wooden dam of the same height as the one placed there in the year 1857, and the Chancery Dam practically became part of the natural bed of the stream.

Across the head of the South Branch a low wooden dam has been built, the crest of which is said to be four inches higher than the crest of the Chancery Dam. From the forebay thus formed water is drawn through three head-races, and the respective rights of parties drawing water from this forebay appear to be established by an agreement or custom of such long standing that it has come to be regarded as mutually binding, being as follows:—

1. The depth of the forebay above the dam on the South Branch is governed by the natural surface of solid rock.

2. The depth of the intakes to the various head-races is governed by the natural surface of solid rock.

3. The width of the various intakes remains unaltered under all circumstances.

4. The owners are entitled to as much water as they can draw through their intakes, defined as above, at all stages of flow.

At low water these three intakes have sufficient capacity to draw the forebay level down one foot or more below the crest of the dam on the South Branch. If the forebay level is drawn down four inches it cuts off the supply of water delivered to the North Branch over the Chancery Dam, it being therefore evident that the owners on the South Branch, drawing water from this forebay have at present the exclusive use of the same during the period of minimum flow.

The low-water head available at present is 53 feet, being the difference in level between water in the forebay above the South Branch dam and water in Gemmill's Bay at the foot of the chute. About 1,500 feet above the South Branch dam and above the fork in the stream another dam is located controlling a head of 7 to 8 feet. It would be physically possible to drown this dam out and raise the level of the South Branch forebay sufficiently to provide a normal head of 60 feet.

From a strictly engineering standpoint, the development of the 60 foot head is the better one for two reasons: (1) Because on a basis of 300 cu. ft. minimum flow it will provide about 200 e.h.p. extra capacity; (2) because by raising the forebay level to the level of the upper river it will afford facilities for night storage which are almost entirely lacking in the case of the 53 ft. head. In addition to the extra 200 e.h.p. continuously available, therefore, the 60 foot development would provide daily storage sufficient to carry a further additional load during peak load hours. The restricted forebay capacity under the 53 foot head would make it necessary to depend upon the natural flow of the stream for peak load requirements, but this latter disadvantage could be overcome to a large extent by arranging with the owners at the upper dam to supply conserved flow from the upper level for peak load purposes when required. This would entail compensation as well as operating costs at the upper dam. These operating costs would be eliminated in the case of the 60 foot development, as the draft on the forebay would then be automatically governed by the requirements of the load.

On the other hand, the 60 foot development will entail considerably greater capital expenditure on account of the additional dam construction, and if it were necessary to decide at once which of the two schemes was the better, a comparison could be made on a cost basis as follows:—

1. Determine the total over-all capital cost of developing the 60 foot head, including damages, legal and promotion costs, and cost of plant for full capacity.

2. Determine the total over-all cost of developing the 53 foot head in the same manner and for full capacity. To which add (1) the capitalized annual cost of supplying peak load storage, (2) the capitalized money value of the additional continuous power which would be available under a 60 foot head.

A comparison of the above totals will then give a fair indication as to which scheme is the more economical.

It is not, however, necessary to make this cost comparison for two reasons: (1) Because the present demand for power in the town of Amonte can be met by developing half the capacity of the site under a 53 foot head; (2) because it is quite feasible, when the demand for power warrants it, to raise the head to 60 feet and make available the additional continuous power and the peak load storage.

The estimates presented herewith will therefore cover only the capital cost and annual charges in connection with the development of the 53 foot head.

The first step towards the consummation of this project would, of course, be to effect a consolidation of the various interests owning or operating on the South Branch, and to place the whole scheme of development under one central control. Under any conditions this control should be vested in the Corporation, but owing to the fact that it now owns the best individual site on the South Branch, the supreme control must come to Municipality, as it will not relinquish what it now holds.

As to the means to be employed to bring about this consolidation, it would seem best for the Municipality to purchase outright such property as is necessary for the building of the plant, and to acquire, also by purchase, all necessary water-rights and privileges; this to be done, however, on the distinct understanding that the industries whose rights have been thus acquired shall in the future be operated exclusively by Municipal electric energy in so far as electric energy is applicable.

It is rather a difficult matter, at the present speaking, to determine just how much electric energy these industries will require to replace the power they are at present obtaining from water. An approximation will be made, however, based on two assumptions, as follows:

(1) That the flow of 300 sec. ft. will provide sufficient power for the industries on the South Branch, such flow being divided according to the respective rights as parties operating thereon.

(2) That the power converted into useful work is in no case more than 50 or 60 per cent. of the theoretical power of the water.

The following table has been compiled on the above assumptions and gives the amount of power each industry can generate with its share of the above flow, and at the head each has available:

Penman Manufacturing Co.	30 h.p.
Golden Fleece Mill	48 "
R. Lee Company	26 "
Municipal Plant	260 "
Almonte Knitting Mill	115 "

Total Hydraulic Power	479 h.p.
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Total Hydraulic Power	479 h.p.
Producer Gas Plant	75 "

Total Power required	554 h.p.
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Power at Turbine Shaft:

From 300 sec. ft. at 53 ft. head	1,450 h.p.
Probable quantity delivered to the Customer .	1,160 "

Assuming that 550 h.p. is the amount of power required to supply the present market on the South Branch, the surplus capacity of the site, according to the above figures, would be 610 h.p. An initial development of half capacity, say 700 hydraulic h.p. would therefore supply the present demand for power.

The Mississippi River affords exceptional opportunities for artificial storage owing to the large lake area in the upper waters, and the full development of this storage might reasonably be expected to double the minimum flow of the river at Almonte, but in the meantime the town can obtain an ample supply of power for present requirements by developing the available head of 53 feet on the South

Branch to the extent of the natural minimum flow. The attached estimate indicates that the actual cost of development is reasonable, but the final cost of power will, of course, depend upon the amount of additional investment necessary to effect a consolidation of the interests owning and operating on the South Branch.

Estimate No. 1 includes the cost of permanent works for the greatest possible ultimate capacity under a 53 foot head, a penstock of 350 sec. ft. capacity, a standpipe for double this capacity, a power-house with capacity for two 750 h.p. hydro-electric units, and one 750 h.p. unit installed.

Estimate No. 2 includes all of the above and also the cost of two more 750 h.p. hydro-electric units, one a spare, and the cost of the necessary addition to the power-house.

In Estimate No. 1 the cost of power is based upon the assumption that 550 h.p. will be sold, and in Estimate No. 2 the cost of power is based on the assumed quantity of 1,325 h.p., which is the amount of power delivered at the switchboard from a flow of 300 sec. feet under a 53 foot head.

Estimate NO. 1—Half Capacity.

Capital Costs:

Power-house, Penstock, Standpipe and Permanent Works..	\$58,934 00
Hydraulic Equipment, 1 unit	6,960 00
Electrical Equipment, 1 unit	11,000 00
Excavation and Unwatering	10,433 00

Engineering and Contingencies, 10%	\$87,327 00
Interest during Construction, 3%	8,732 00
	2,619 00

Total Capital Cost	\$98,678 00
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Capital Cost per h.p., on basis of 750 h.p. delivered to switchboard ..	\$131 50
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Annual Costs:

Power-house, Penstock, Standpipe and Permanent Works..	\$1,155 00
Hydraulic Equipment	348 00
Electrical Equipment	620 00

Total Maintenance and Depreciation	\$2,123 00
Interest, 4½% on \$98,678.00	4,440 00
Sinking Fund, 1.8% on \$98,678.00	1,775 00
Operation and Administration	2,000 00

Total Annual Charges	\$10,338 00
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Annual Cost per h.p., on basis of 550 h.p. sold	\$18 80
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Estimate NO. 2.—Full Capacity.

Capital Costs:

Power-house, Penstock, Standpipe and Permanent Works..	\$65,000 00
Hydraulic Equipment, 3 units	20,880 00
Electrical Equipment, 3 units	21,975 00
Excavation and Unwatering	11,433 00

Engineering and Contingencies, 10%	\$119,288 00
Interest during Construction, 3%	11,929 00
	3,578 00

Total Capital Cost	\$134,795 00
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Capital Cost per h.p., on basis of 1,325 h.p. delivered to switchboard ..	\$101 60
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Annual Charges:

Power-house, Penstock, Standpipe and Permanent Works..	\$1,300 00
Hydraulic Equipment	1,044 00
Electrical Equipment	1,295 00

Total Maintenance and Depreciation	\$3,639 00
Interest, 4½% on \$134,795.00	6,060 00
Sinking Fund, 1.8% on \$134,795.00	2,423 00
Operation and Administration	3,000 00

Total Annual Charges \$15,122 00

Annual Cost per h.p., on basis 1,325 h.p. delivered to
switchboard \$11 40

August 29th, 1911.

REPORT NO. 24.

Rideau System.

Bolingbroke.

The water from the following lakes flows through Bolingbroke into the Tay River, and finally through the Tay Canal into the Upper Rideau Canal:—Carnahan, Kellar, Long, Miller, Leggat, Eagle, Elbow, Buck, Crow, and Bob's Lakes.

There is a Government wood and rock fill dam at the outlet of Bob's Lake at Bolingbroke with a head on July 19th of 7 ft. This dam has one sluiceway with stop logs. There is one foot of fall between it and another dam 450 feet down stream owned by Mr. Dowdell of Bolingbroke. Dowdell's dam is in a dilapidated condition, but is being used at times to supply a saw mill and a grist-mill. Not much work is done in either mill. This dam had a head on July 19th of 7 ft. 3 in. This would make possible a total head at the second dam of between 15 ft. and 18 ft. without doing more damage to farms above than has already been arranged for by the Government. It is understood that at present the Government has a right to build only at or above its present site.

The present Government dam is 81 ft. long, 12 ft. 4 in. wide at the top, and 13 ft. 1 in. from the top of the dam to the creek bed and has one sluiceway 9 ft. 6 in. long with stop logs rising 7 ft. above the sill. Water was flowing over the stop logs on July 19th at an average depth of 9 in. The dam is situated between rocky banks, which rise about 20 ft. above it. Dowdell's dam is frame and rock fill, 24 ft. long with a sluice 5 ft. in length. The water in Bob's Lake could be raised about 4 ft. without doing much damage to surrounding properties.

Lyndhurst.

The water powers owned by Geo. Roddick and Mr. Harvey of Lyndhurst were also investigated, and the following information obtained.

The water here is supplied for the most part by Upper and Lower Beverley Lakes, supplemented in the fall, winter and spring by the surplus from the Rideau Canal through Morton Creek. During the months of navigation no water is taken from the Rideau except that which leaks through the stop-log dam at the Morton Creek outlet of Whitefish Lake.

The Roddick and Harvey dams are situated just south of the Lyndhurst road bridge, the centre pier of which forms part of the dam and is, in fact, the section dividing the two dams. These dams are of irregular shape and built of concrete, Roddick's dam being approximately 60 ft. long with a wing dam of 50 ft., and Harvey's 95 ft. in length. The former has a 14 ft. sluiceway with stop logs, with 7 ft. 5 in. water on the sill. Roddick's has a saw mill and a grist mill running most of the time. The grist mill wheel, a 36 in. Giant, is fed through a 24 x 26 in. gate, and the saw mill through a 17 x 20 in. gate. These gates were running full on July 22nd. Mr. Harvey also owns a saw mill and a grist mill at Lyndhurst. The saw mill is fed through a wood flume, 3 ft. by 4 ft. 2 in. outside, and has a 33 in. Little Giant wheel. The grist mill is fed through a wooden flume 4 ft. in diameter and has two wheels 18 in. and 24 in., Little Giant, respectively. These mills were not running on July 22nd, but it is said that they are run for the greater part of the year.

Harvey's dam has two sluiceways, one 18 ft. and the other 9 ft. in length. The depth of water is about 11 ft., but is not to be taken into consideration as there is a ledge of rock about 200 feet up stream running clear across the channel, and about 3 ft. from the surface. There is a fall of about 17 ft. 6 in. at Lyndhurst.

Bedford Mills.

At Bedford Mills there is a fall of approximately 30 ft. There are three mills being run by water-power:—saw mill, shingle mill, and grist mill—all owned by Tett Bros.

The saw mill is run by a 27 in. Little Giant wheel with a head of 18.7 feet. A flume runs from this lower level to the shingle and grist mills with a head of 11.5 feet, the surplus water from the saw mill being carried off by a waste weir 14 ft. long. The water here was 10½ in. deep on July 20th.

The concrete dam above the saw mill is 60 ft. long and has four gates, one 3ft. by 4 ft. and the other three each 4 ft. by 5 ft. On July 20th there was 10 ft. 6 in. of water on the up-stream side of the dam, and only one gate partially opened. There was no way of finding out what the discharge area was on that date.

The reservoir for the Bedford Mills water power is Devil Lake, and this lake receives its supply from the following:

Garter, Canoe, Elbow, Sand, Eel, Desert, Mud, Knowlton, Otter, Little Clear, Little Salmon and Birch and a few other smaller lakes.

Between the “Narrows” and Kingston there are the following locks and dams:

Station.	Distance between Stations.	Locks.		Dams.	
		No.	Lift.	No.	Length.
Narrows.....	4¼ miles	1	2 ft. 4 in.	1	.....
Isthmus	4⅝ “	1	6 “ 5 “	.....	.....
Chaffey’s	2⅝ “	1	10 “ 10 “	.....	.....
Davis	2⅝ “	1	9 “ 2¼ “	1	270 ft.
Jones Falls	11 “	4	58 “ 5½ “	1	400 “
Upper Brewers.....	1¾ “	2	19 “ 8 “	1	130 “
Lower “	10¼ “	1	13 “ 0 “	1	120 “
Kingston Mills	6 “	4	44 “ 0 “	1	176 “
Kingston		0	0 “ 0 “	.....	.....

Locks are 134 ft. long and 33 ft. wide.

The Isthmus is between Upper Rideau Lake and lies between Upper and Lower is the original outlet of Upper Rideau Lake and lies between Upper and Lower Rideau Lakes.

At Davis Locks there is a by-wash 30 ft. long with stoplogs. At Jones Falls on the upper level there is a by-wash 27 ft. long with stop-logs 14 ft. long and 11ft. above the sill. Below the first lock there is a regulating basin with a sluice-way, 2ft. by 4 ft., in a 70 ft. dam. This was running full on July 21st. The water passing over Jones Falls is supplied as follows:

Newboro Lake with its tributaries which comprise that part of Upper Rideau Lake which is used for lock purposes at the Isthmus, the Devil Lake range mentioned previously in the report; Mississagwa Creek range, which comprises Lakes Clear, Slide, Bear, Draper, Indian, North Bay, South Bay and Buck and Little

Lake; Newboro Lake waters join Mosquito, Clear and Indian Lakes, and flow through Chaffey's Lock into Opinicon Lake. Here these waters are supplemented by those from Long, Stonehouse, Upper Rock and Crow Lakes, and a certain part of the surplus from Loughboro Lake during high water, and flow through Davis Lock into Sand Lake and thence to Jones Falls.

There are several means of storing the flood waters above Jones Falls. At Bedford Mills the present dam, which controls the Devil Lake range, could be raised, thus improving Tett's power development there. Also the Mississagwa range could be dammed as it has been in the past. This dam was washed out some time ago and has not been replaced. The water powers at Mississagwa and Bedford Mills are both owned, it seems, by Tett Bros. of the latter place. Also the surplus water from Loughborough Lake, which is twenty to twenty-five miles long, could be made to pass into Opinicon Lake and thence to Jones Falls by raising the present dam at Battersea, and rebuilding the old dam at the northern outlet of the lake.

There is at present at Jones Falls a stone dam built by the Government which is in excellent repair. This dam is in the form of an arc of a circle and is about 400 ft. long and 60 ft. high. There are also four locks.

At present practically all the water passing through Jones Falls reaches Kingston Mills, where there was a head on July 23rd of 44 ft. The flow of water is increased by the surplus from Loughborough Lake, which has its present outlet at Battersea and flows into Dog Lake. There is a fall of about 60 to 70 feet between Loughborough Lake and Dog Lake, and three dams in that distance. Troy, Little Cranberry, Horseshoe, Crow Nest and Mud Lake also augment these waters.

Before the Rideau Canal was built the natural outlet was through Morton Creek into the Gananoque River. However, the Government has built a dam at the head of Morton Creek, and now no water goes that way during navigation season except that which leaks between the stop-logs of the dam. When water is not needed for canal purposes, about two-thirds of the surplus water is allowed to go through Morton Creek. It is said, however, that the Gananoque River has no legal right to this surplus and that therefore the Morton dam could be made to hold back all the surplus water, and that this could be used at Kingston Mills for power purposes. The Morton Creek Dam is 100 ft. long, with a sluiceway 17 ft. 10 in. wide, and a fall of about 16 feet.

July 19th, 1911.

CHAPTER VI.

MUNICIPAL WORK.

MUNICIPAL ADVICES.

Municipal Department.

The Municipal Department is employed to secure the necessary information for the preparation of estimates on the cost of supplying power to those districts desiring it through data collected by surveys of the districts and investigations of the possible power demands. These investigations are made, and estimates submitted at the request of the municipalities desiring power. After a contract for supply of power has been made between the municipality and the Commission, the latter acts as consulting engineer when so requested, and is expected to prepare engineering plans, specifications, call for tenders, and supervise the erection of the necessary material and apparatus. Later, after power is delivered, this Department aids the municipality in building up its power load by acting as a power solicitor, and advising the town and consumers regarding the amount of power necessary and the proper electrical equipment.

The standardization of apparatus, unification of rates and the inauguration of standard accounting systems are also under the direct supervision of the Municipal Department, which is expected to give advice on questions of an electrical nature at the request of any municipality in the province.

The work accomplished by the Department during the period covered by the report is given in detail in what follows; the municipalities being arranged in alphabetical order:—

Acton.

A request was received from the Village of Acton in October, 1911, for an estimate on the cost of supplying the village with energy. Estimates were prepared on the assumption of extending the line at present running to the Guelph Agricultural College, through the Prison Farm at Guelph, to serve Rockwood and Acton. These were submitted on October 23rd.

The clerk of the village advised us on November 1st, that the Council had decided to submit a by-law to the ratepayers of the village, at the municipal election in January, for an authorization to contract with the Commission.

Almonte.

See report on High Falls Distribution and Hydraulic Report.

Athens.

See Report on Eastern Municipalities.

Aurora.

The Chairman of the Electric Light Commission of Aurora forwarded resolution to us on March 22nd, 1911, requesting an estimate on the price of supplying 100 and 150 h.p. to Aurora. Acting in accordance with this request, the entire district adjacent to Aurora, Newmarket, Markham, was examined during the summer, to determine the possible power demand, and a preliminary report submitted emphasizing the necessity of co-operation between the different municipalities in the district, to provide for economic distribution. An engineer was again sent to this district in October, and as a result the authorities of the different municipalities are now planning to present a united demand for power.

Baden.

The Board of Trustees of the Police Village of Baden passed a resolution on June 4th, 1910, requesting an estimate on the cost of supplying power to the village.

Our engineer attended a meeting of the village trustees and prospective power users, on June 17th, in Baden, and advised the trustees as to the action necessary to forward the matter since the police village was dependent upon the action of the township council. The village also required an estimate on the cost of a distribution system.

A contract was prepared and forwarded to them on October 15th, for 150 h.p. at an estimated cost of \$31.00 per h.p. per year, at 13,200 volts, together with an estimate of the cost of a distribution system. Several visits were later made by the engineers, but no further action could be taken until a petition had been submitted to the township council. This petition was forwarded to the Commission on April 21st, 1911, together with a request for full information as to the procedure to be followed. They were then advised to proceed in accordance with the Act passed during that winter, providing for the local distribution of electrical energy, and on April 27th our engineer visited Baden, explained the procedure to be followed in accordance with the new Act, and secured complete data for estimates on the cost of power and a distributing system in accordance with this same Act. Several other visits were made to the town; considerable information and forms of model by-laws were also supplied.

The by-law for power which authorized the Board of Trustees to contract immediately for 40 h.p. at 2,200 volts, at an estimated cost of \$36.95 per h.p. per year was presented and carried on July 22nd. Plans and specifications for a complete distributing system were prepared, and the necessary material and equipment ordered after a money by-law for \$5,000.00 had been presented and carried on October 23rd.

Plans and specifications were also prepared for the sub-station, and sent to the Board of Trustees, who made a local award of the contract. The station was under construction by the close of the year, and arrangements made so that the work could be rushed to completion as soon as the material for the distributing system had been received.

REVISED DISTRIBUTION ESTIMATE FOR BADEN.

		Cost.	Per Cent.	Annual Charges.
45	30 ft. poles, 7 in. tops, erected at \$5.00.....	\$225	8	\$18
50	6 pin cross arms complete, with braces and hardware, at \$1.00 each	50	8	4
300	pins and insulators erected at 25c.	75	5	4
20M	feet of No. 6 B. & S. copper T.B.W.P., at 20c. a lb.....	462	2	9
10M	“ 8 “ “ “ “ 20c. “	151	2	3
	“ 4 “ “ “ “ 20c. “	334	2	7
3	5 kw. 2200-110 volt trans. erected at \$80.00	240	6	14
1	10 kw. 2200-110 volt service trans. at \$105.00	105	6	6
42	street lights, brackets, shades, and sockets erected at \$8.00	336	6	20
50	house services at \$10.00 each	500	6	30
50	house meters at \$10.00 each	500	6	30
3	solenoid switches installed at \$20.00.....	60	6	4
		\$3,038	.....	\$149
Engineering and contingencies, 10 per cent.....		304	.....	15
		\$3,342	.....	\$164
Interest during construction, 2 per cent.		67	.....	3
		\$3,409	.....	\$167
Lamp renewals				175
Interest, 5 per cent.				170
Sinking fund, 30 years				61
				\$573
SUMMATION.				
Station.....		800	.....	32
Line		3,409	.....	573
		\$4,209	.....	\$605

Beachville.

At the request of the Village Trustees, a representative was sent to Beachville on April 19th, 1910, to confer with their Board and power-users relative to a supply of power for that village. They were advised that it was necessary for the township to take action, and the trustees promised to bring the matter to the attention of the Township Council.

One of our engineers met the Township Council on May 10th, and explained the project to them. Considerable survey work was done during the month of June to locate a supply to Beachville, and an estimate on the cost of 100 h.p. at \$28.50 per h.p. per year was submitted on September 1st. A number of the prospective consumers in or near Beachville later requested information regarding the necessary equipment. We were officially notified on December 9th, that the township could not take action.

On January 6th, 1911, in answer to a request, information was again supplied them regarding the cost of building lines at different standard voltages, so that the estimated cost for poling the township might be secured, and on January 14th we received a map from the Township Clerk, with a request for an estimate on the cost of constructing a distributing system to supply the consumers indicated on the map. This map was of great value to us at that time, since the Act provided for the local distribution of electrical energy was under consideration. On February 2nd we advised the Secretary of the Board of Trustees of Beachville that this action was pending. However, the Township decided not to contract, but author-

ized Ingersoll to supply electrical energy to Beachville. Ultimately they decided to avail themselves of the authority granted them in the Power Commission Act of 1911, and accepted an estimate dated June 30th for 100 h.p.

An engineer visited the town a number of times during the summer to secure action, but for one reason or other it was delayed until August 28th, when they advised us that they were drafting a by-law. We assisted them in the preparation of this by-law which was presented and carried on the 20th of October, a money by-law for \$5,000.00 having been introduced at the same time. Meanwhile, the Commission contracted for the electrical equipment of the station, as an agreement had already been made with the Standard White Lime Company of Beachville for 50 h.p. at \$39.50 per h.p. per year.

We were advised on October 21st that both by-laws had been carried by a vote of 81 to 5, and the proposed contract was then submitted for signature.

Beamsville.

See Report on the St. Anne's District.

Berlin.

The Water Commission of Berlin requested our recommendations in April, 1910, regarding certain types of electrically driven pumps. Investigation was made for Berlin and other municipalities, but no written report submitted.

Our engineer was again sent to Berlin to inspect the electrical installation in the Municipal Station at the request of the Berlin Light Commissioners in Sept. 1910. A number of changes were recommended, sketches made showing the most approved arrangement of installing the high tension work, and a copy of this report submitted on September 13th.

These same Commissioners later, on October 3rd, requested that our Engineering Department act as a consulting body for their Commission.

During the inauguration of the power service in Berlin representatives were sent to assist the local authorities in decorating and also in installing the desired equipment in the auditorium and streets.

The rates which had been adopted by the Light Commission were sent to us for approval in December. These were ratified with a number of unimportant changes; the rates submitted being the standard rates prepared by the Committee of Municipal Engineers. (See Report on Rates.)

On March 3rd, 1911, the Berlin Light Commissioners requested that an engineer be sent to collect data for recommendations as to the rate which the Street Railway Department should be charged by the Electrical Department. Our engineer visited them on March 9th, and submitted recommendations in a report on March 18th.

Further visits were made by our Engineers in order to secure additional information. Other reports were submitted on April 6th, September 7th, and September 29th.

An engineer was sent to investigate the conditions of a large prospective power-user on July 5th. This investigation resulted in a contract for additional power in that district.

Another request was received on August 25th for an engineer to further investigate and recommend the power charge to the Street Railway Department as well as to the other railways purchasing power from the Railway Department of the Light Commission. Recommendations were also requested regarding street lighting, and the advisability of maintaining the municipal gas producer plant.

A complete report was submitted relative to these subjects on September 7th. Our representatives now visit Berlin at regular intervals to secure reports on construction progress, the prospects of power sale, assist in the sale of power, and also to advise on any difficulty that may arise.

Beverley.

See Report on Rural Distribution.

Blyth.

The Clerk of Blyth wrote us on May 2nd, 1911, to ascertain whether or not plans had been made for supplying power to Blyth and the surrounding district. He was advised that the entire district was under consideration, and a complete power scheme being prepared. (See Report on Huron County.)

Brampton.

We advised the Town Clerk of Brampton, on November 15th, 1909, that a request for power had been received from Port Credit, that we had revised the estimates previously submitted to Brampton and Milton, and that the estimated cost of power supplied to Brampton would be \$29.75 per h.p. per year. Following our receipt of the application from Port Credit, a number of estimates were prepared to determine the most available location for a station to supply power to the district. Finally, after being advised that Milton could not contract for power, the station was definitely located at Port Credit, and in December the following estimate on the proposed distribution system was sent to the Town Clerk of Brampton.

ESTIMATE ON LINE MATERIAL FOR 2,200 VOLT POWER LINE, WITH TOTAL LENGTH OF 12,490 FEET.

	Capital Cost.	Per Cent.	Annual Charges.
133 poles with crossarms at \$11.00.....	\$1,463	8	\$117
400 insulators at 25 cents.....	100	6	6
18,687 lb. of copper conductor erected at 20 cents.....	3,737	2	75
Extra line hardware.....	250	6	15
50 poles for branch circuits at \$10.00.....	500	8	40
550 insulators for secondaries at 10 cents.....	55	6	3
2,800 lb. of No. 6 copper conductor for secondaries erected at 20 cents (80 lb. per 1,000 feet).....	560	2	11
150 wattmeters erected and sealed at \$16.00.....	2,400	6	144
25 lighting transformers with arresters at \$100.00..... (Power transformers, ratio 2200-575 volts, to be furnished by power users.)	2,500	6	150
	11,565	.....	561
Engineering and contingencies, 10 per cent.....	1,157	.....	56
	\$12,722	.....	\$617
Interest during construction, 1½ per cent.....	191	6	11
Total cost line and service	\$12,913	.....	\$628
Interest and sinking fund, 5.8 per cent. on \$12,913 .....	.....	.....	749
Lost power 20 h.p. at \$29.50.....	.....	.....	590
Total annual charges .....	.....	.....	\$1,967

ESTIMATES ON THE PROPOSED DISTRIBUTING SYSTEM FOR BRAMPTON.

List of Power-Users shown on Map:

1. Williams Shoe Co.	75 h.p.
2. Copeland-Chatterson Co.	75 "
3. Brampton Milling Co.	60 "
4. Colver Co.	25 "
5. Canada Shoe Co.	50 "
6. Brickyards	75 "
7. Finlay & Co.	10 "
Total	370 h.p.

Estimate provides for interest at 4 per cent. and sinking fund at 1.8 per cent. figured for 30 year fund at 4 per cent.

Meanwhile by-laws had been prepared which were presented to the rate payers and passed in January of 1910 after which a contract was signed for 500 h.p. The Money By-law authorized the expenditure of \$40,405 for a distributing system but made no allowance for street lighting.

The Port Credit Brick Company's contract, which had been previously signed, was later assigned to Brampton, and the contract with Brampton increased to 1,300 h.p.

In July, at the request of the Mayor, our engineer was sent to Brampton to suggest a location for the sub-station and give advice relative to construction work. The Engineering Department of the Commission was also requested, in a resolution passed by the Town Council, to act as the Consulting Engineer of the town.

Our Engineer was sent to Brampton on November 18th to investigate local conditions, and on November 19th a report was submitted advising methods of carrying on construction. Advertisements were later inserted in the papers for a Station Superintendent, and from the many applicants a superintendent was finally appointed.

The station site was chosen and purchased by the town. Specifications were prepared for the electrical equipment of the Municipal sub-station, and forwarded to the town on January 4th, 1911. Action was taken and we were advised on February 7th by the Town Clerk that the specifications had been approved. Tenders were therefore at once called for.

We submitted specifications for the transformer station on March 15th on which local tenders were requested for its construction. Further tenders received by the Engineering Department were sent to Brampton with comments.

The recommendations of the Hydro-Electric Committee at Brampton were adopted on March 21st, 1911, by the Town Council, and we were requested to place on order the poles and prepare a list of the material required.

We recommended the acceptance, on April 1st, of the tender of the Canadian-Crocker-Wheeler Company for transformers, and of the Canadian Westinghouse Company for the remaining equipment. Contracts were awarded as recommended. Meanwhile, the tender for the building had been awarded to a Brampton contractor, and construction work was started.

Upon our receipt of a request signed by the Council and the owner of the local Electric Light Plant that we make a valuation of the existing system in Brampton, an engineer was sent to take an inventory of the entire equipment.

During the erection of the sub-station and distributing system, our engineer spent at least one day a week in the town. The greater portion of the material required for the distributing system has been ordered, the plans have also been prepared, and the installation of the equipment in the sub-station has been in-

spected. The distributing system is still under construction and our engineer on his weekly visits, in addition to his other duties, interviewed prospective power-users. Weekly progress reports and inspections will be continued until the system is in operation.

The schedule of rates employed at Brampton is a modification of those employed in the City of Toronto, and was adopted on July 11th, 1911, at our recommendation.

Previous to delivery, the transformers for the station were tested at the factory. These tests were witnessed and approved by our engineers before they were finally accepted.

Power was delivered temporarily to Brampton for a convention on August 11th, 1911, but it was not until October 16th that the equipment was ready for continuous service.

Bridgeburg.

A letter was received from the Clerk of Bridgeburg, on March 8th, 1910, requesting an application blank, which was at once sent and formally returned to us on May 13th requesting an estimate of the price of 200 to 500 h.p. delivered at Bridgeburg.

The following estimate was submitted for the cost of 12,000 volt power delivered at Bridgeburg on August 16th:

August 8th, 1910.

ESTIMATE COST OF POWER TO BRIDGEBURG.
12,000 VOLTS FROM NIAGARA STATION.
SINGLE CIRCUIT LINE ON DOUBLE CIRCUIT POLES ALONG THE ROAD, 20 MILES.

Horse Power.	Cost of Power at Falls.	Depreciation, Administration, Operation and Lost Power.		Interest and S.F.		Total Cost per h.p. per Annum.
		TOTAL.	Per h.p.	TOTAL.	Per h.p.	
200	\$9.40	\$3,419	\$17.10	\$2,263	\$11.31	\$37.81
300	9.40	3,538	11.79	2,285	7.62	28.81
400	9.40	3,749	9.37	2,629	6.58	25.35
500	9.40	3,881	7.76	2,651	5.30	22.46
750	9.40	4,606	6.14	3,411	4.55	20.09
1,000	9.40	5,050	5.05	3,824	3.82	18.27
1,500	9.40	6,095	4.06	3,980	2.65	16.11
2,000	9.40	7,012	3.51	4,516	2.26	15.17

Brockville.

See Reports on Eastern Municipalities.

At the request of Brockville Power and Light Department, an engineer was sent to Brockville to investigate the cost of power as generated by steam, and from this data recommend a schedule of prices to be employed for light and power. As a result of these investigations the use of a modified form of the Toronto schedule for the sale of light and power was recommended and sample account blanks were furnished. The town further requested advice on the purchase of transformers and motors for use on their lines, and preliminary information regarding a motor-driven pump with a capacity of five to six million gallons per day.

Brockville Asylum.

See Report on Department of Public Works.

Caistor Centre.

See Report on Rural Distribution.

Caledonia.

See Report on the Cayuga District.

Cardinal.

See Report on Eastern Municipalities.

Cayuga.

Acting in compliance with requests for an estimated cost for power delivered in the district adjacent to Cayuga and Caledonia, an engineer was sent to investigate the power requirements of the towns of Hagersville, Cayuga, Caledonia, Dunnville, and the surrounding districts.

The authorities of the various municipalities were visited, and the majority found to be in favor of arranging with the Commission for a supply of electric power for municipal, as well as for industrial purposes.

The estimated demands were as follows :

Hagersville	153 h.p.
Cayuga and District	594 “
Caledonia	450 “
Dunnville	200 “

Action will probably be taken by these municipalities at the elections in January.

Chatham.

A number of estimates have been prepared for an assumed demand in Chatham in connection with those for Windsor. See Windsor Report.

Clinton.

See Report on Huron County.

Collingwood.

A letter was received on November 22nd, 1909, from the Chairman of the Water and Light Commission of Collingwood, requesting information for use in dealing with a proposition they had received from a private concern to supply

energy to the town. This was supplied them and on April 18th, 1910, a letter was received stating that they wished to purchase a 60-cycle machine and asking us if any of the municipalities in the Niagara District had such a machine for sale. Copies of this letter were sent to the different municipalities advising them to reply direct.

A request was later received from the President of the Board of Trade of Collingwood for an estimate on a supply of power. Correspondence relative to the possible methods of supplying the town followed, and on May 10th we advised them that we were preparing a report on the entire district.

(See Report on Durham District.)

A report on the Electric Light and Water situation in the town, and our recommendations for the present, with the view of ultimately introducing Hydro-Electric power into this section, was requested on August 30th, and an engineer was sent to collect the necessary data for the report.

Courtland.

See Report on Rural Distribution.

Deseronto.

See Report on Eastern Municipalities.

Drumbo.

In reply to an inquiry from a citizen of Drumbo, we wrote on July 7th referring to the method of procedure outlined in the Act respecting the local distribution of electric power. On July 19th a copy of this Act was sent to the Chairman of the Board of Trustees, together with advice as to procedure, and on July 26th a resolution was received requesting an estimate on 25 h.p. Following this and other municipal applications from the same district, an engineer was sent to investigate the conditions. The accompanying report was submitted:

REPORT OF ENGINEER ON CONDITIONS IN DRUMBO AND VICINITY.

On Tuesday, October 31st, and Wednesday, November 1st, 1911, I visited Drumbo, Plattsburg and vicinity. At Drumbo I met Mr. J. A. Mitchell, Secy., Board of Trustees, also the Reeve and a number of prospective users of electrical power in Drumbo, Wolver, Richwood, Blandford and Innerkip. At Plattsville I met Mr. W. E. Baldwin, Secy., Board of Trustees, and a majority of the manufacturers and prospective users of electric power in Plattsville, Washington, Bright, Chesterfield and vicinity. The residents of Drumbo and Plattsville are very enthusiastic over the subject, and wish to secure estimates for a supply of power as soon as possible. Drumbo has applied for 25 h.p. and Plattsville for 130 h.p. I have been able to obtain the following information concerning the municipalities in this section:

Drumbo.

Population 376.

At present using 14 h.p. (steam) and 20 h.p. (gasoline) in the village, and about 50 h.p. (steam) in the near vicinity. The village would require from 15-20 h.p. for lighting, and could probably use a total of from 30-35 h.p.

Plattsville.

Population about 500.

At present using from 175-185 h.p. (steam and water) would probably use from 125-135 h.p. electrical power for constant use, and an extra 35-40 h.p. for intermittent summer use.

Innerkip.

Population 300-400.

At present using 45-50 h.p. (steam) and about 5 h.p. gasoline. The village would require about 20 h.p. for lighting, and would probably need a total of from 25-30 h.p.

Milverton.

Population 100.

The grist mill at present using a combination of steam and water utilizes a maximum of 100 h.p. A cider mill is also using 20 h.p. (steam) and there are three gasoline engines in the village aggregating from 8-10 h.p. The mill would probably require electrical power to the amount of 75 h.p.

Bright.

Population 300.

At present using from 20-25 h.p. (steam). Would probably use about 15 h.p. electrical power.

Richwood.

Population 50.

No power in use except from 4-6 h.p. (gasoline). Would use small amount for lighting.

Blandford.

Population 50.

Same as Richwood.

Washington.

Population 50.

Same as Richwood.

Chesterfield.

Population 50.

Same as Richwood.

Village.	Present Load.	Probable Load.
Drumbo	70—80 h.p.	30—35 h.p.
Plattsville	175—185 "	125—150 "
Innerkip	45—50 "	25—30 "
Wolverton	120—130 "	70—75 "
Bright	20—25 "	10—15 "
Richwood . . . . .	..	..
Blandford . . . . .	..	..
Washington . . . . .	..	..
Chesterfield . . . . .	..	..

Dublin.

See Report on Rural Distribution.

Dundas.

A by-law was submitted and approved by the ratepayers of Dundas on January 4th, 1909, authorizing the Council to contract with the Commission for power. No further action, however, was taken until the middle of September, 1910, when the Council requested that an engineer be sent to Dundas to estimate the cost of installing a Municipal Distribution System. In accordance with this request an estimate was submitted to the town on September 17th, giving a total estimated capital cost of \$30,109.00.

Additional agitation was again evidenced in September and October, and public meetings held which were attended by representatives who advocated the immediate construction of a distributing system, in spite of such difficulties as an existing contract for street lighting. Representatives were instructed to call on the power-users to ascertain the available market and determine the amount of power which could be sold in the town.

Since the enabling by-law had been passed, it was finally decided to consider a power contract, and proposed contracts were submitted on November 3rd, 1910. These were signed, and returned by the Council to the Commission on November 7th. The contract called for 600 h.p. at an estimated cost of \$17.33 per h.p. per year.

The manufacturers in Dundas were anxious to purchase Hydro-Electric power, and it was necessary for our engineers to make a number of visits to Dundas to investigate the requirements of the individual consumers, estimate the amount of power and make recommendations as to the equipment which each would require. It was soon found that it would be necessary to supply the power for a part of this demand immediately, and although the Council had signed the contract for power, they had not passed a Money By-Law, and it was, therefore, necessary to prepare and submit a Money By-Law for \$12,000.00 on January 2nd, 1911. This was carried by a large vote.

Meanwhile the Engineering Department was engaged in purchasing the equipment for our Dundas Station, and building a 2,200 volt feeder circuit to Dundas, in order that we might deliver power to a consumer in Dundas, with whom a contract had already been made. All this work was laid out, the material purchased, and construction completed by the Engineering Department. Three transformers stepping down from 13,200 to 2,200 volts were purchased, together with a temporary switching equipment to supply power to the 2,200 volt line. These were completely installed in the Dundas Station within a month and by the first of the year Dundas was supplied with energy.

Despite the fact that the Money By-law had not been passed, it was necessary for the Engineering Department to continue constructing the Distribution System, and soliciting consumers, for debentures had not then been issued, and the town did not have the necessary money to continue the work.

This construction work required the services of a Construction Engineer, a line-gang and a second engineer, the latter spending at least two days a week in Dundas laying out the complete distribution system, and taking care of the engineering work incident to the inauguration of the system. A large amount of work was also taken care of at this time; such as the preparation of reports for the various power-users, visits to the officials of the various manufacturing companies, and the supervision of many details of the distributing system which was to supply these prospective users with power.

A curve-drawing voltmeter was installed in the Town Hall, a superintendent

was engaged to take care of the work in the Town, and standard schedule rates with a local discount of $33\frac{1}{3}$ per cent. were adopted.

A contract was placed for the Town to provide for an annual supply of Carbon Lamps, and a report submitted to them regarding the power used by the Bertram Machine Works, tests being made on each one of the motors in the factory.

One of our engineers was instructed to visit Dundas at least twice a week to supervise the power-soliciting and engineering, while a construction engineer had charge of the construction gang, the building of the Distributing System and the connection of the different services for power and light. A large part of the detailed work was handled in this way, the system nearly completed and taken over entirely during the summer, so that, at the present time, the construction work is being looked after by the town, although the engineering, purchasing, planning of extension, soliciting of power, and all other different questions which arise in the operation of every municipal system are taken care of by our engineer who spends at least one day a week in Dundas, which has, at the time of writing, a large number of light users on the system, and a fair number of power users with contracts totalling several hundred horse power.

Dunnville.

See Report on St. Ann's District.

Durham and Durham District.

We received a letter in the spring of 1911 from the Mayor of the Town of Durham asking for an estimate on the cost of supplying from 1,800 to 2,000 h.p. to the Town. We advised them on May 8th that their entire district was under consideration.

A number of requests had also been received from municipalities north and west of Guelph, Stratford and through the Georgian Bay District for estimates on the cost of supplying power to them. Several estimates were prepared on the cost of supplying power to these towns individually, or as small branches of the Niagara System; but later, it was found necessary to treat the district as a whole in order to submit satisfactory estimates to the various municipalities.

During the summer of 1911, engineers were sent into this district to secure information for a report on the conditions existing, available data regarding small water powers and the probable demand for power.

The data secured from these different municipalities are as follows:—

REPORT ON DURHAM AND DURHAM DISTRICT.

Beginning Monday, June 12th, the following municipalities were visited and the accompanying information obtained.

Hanover.

The conditions at Hanover are as follows: The majority of the industries are wood-working and furniture factories using waste or refuse in varying quantities under their boilers for fuel.

The largest plant owners, Knechtel's, state that they have sufficient refuse for all purposes of mill drive as well as for heating their kilns.

The other factories, however, can employ electrical energy in their plants to advantage, and at the same time utilize the refuse for heating their kilns, or other similar purposes, thereby enabling them to install a more economical system, and

employ electric motors to operate their plants more effectively and advantageously as regards output.

Relative to the wood-working plants, it is recommended that all data in connection with wood-working factories in these towns, such as methods of drive, the economical utilization of refuse, with costs, etc., all of which are of great value and material assistance, be collected for future use.

The conditions encountered at the Cement Plant and around town generally indicate that the municipality could seriously consider the employment of Hydro-Electric power.

The town can easily use 50 h.p., and the various industries from 200 to 300 h.p.

Listowel.

The possible load at Listowel occurs principally in wood-working factories, where conditions similar to those at Hanover exist. There has been considerable agitation here relative to the use of Hydro-Electric power, and it was, at that time, receiving careful consideration.

After luncheon on Tuesday, an informal meeting was held, and attended by our representative and six of the leading business men, since the mayor and manager of the Listowel Furniture Company were both absent from town. The industries in the town were visited. The amount of power required by the town alone would, roughly, approximate 50 h.p., and by the industries from 175 to 200 h.p. Attached to these reports is the financial statement of the town for 1910, also rules and regulations relative to their water and light rates.

Durham.

The conditions at Durham are as follows:—

With the exception of the National Portland Cement Works, all the industries in the town are operated by water-powers on the Saugeen and Rocky Saugeen River. There is no municipal light or water works, or sewerage system. The town is supplied with power for light from a water-power development owned and controlled by a plant (McIntyre) situated about two miles away. No franchise is held, and the arrangements to provide for the lighting of the town are made each year with the council.

Mr. Calder, President and Manager of the Cement works, seemed desirous of having Hydro-Electric power supplied to the section and stated that the cement works could utilize from 800 to 1,000 h.p.

The Durham Furniture Company (Dr. Jameson, President, Mr. Catton, Manager) are developing a water power on the Rocky Saugeen, four miles from town, and expect to secure at least 250 h.p. for a 10 hour day. They are installing a 187 kw., 4,400 volt, three-phase, 60-cycle generator. The energy generated will be transformed at the factory to 220 and 110 volts for motors and lights. They expect to have from 75 to 100 h.p. surplus energy for disposal in the town or its vicinity.

The town is now considering supplying power to the Cement Company for a period of years to protect themselves against the loss of this industry and thereby securing cheap power for municipal purposes.

Now that the surrounding municipalities are discussing the feasibility of employing Hydro-Electric power, and the advantages derived by its use for the district, it is probable that Durham will give the matter consideration.

Collingwood.

The population here is 3,500. Mr. J. Currie is Mayor, and Mr. Chamberlain, Chairman of the Light and Power Commission. The town has municipal lighting, power and waterworks plants. The installation consisting of the following equipment:

Water Works.—2 steam pumps, each 1,500 gallon capacity, for 24 hours, installed about 20 years ago.

1 150 h.p. "Abell" engine.

1 100 h.p. "Abell" engine, belt connected to counter shaft, driving a 120 kw. C.G.E. type "A" No. 2776, 1070 r.p.m., 1154/1040 volt single-phase alternator.

1 Chapman and Walker gas producer engine, 104 brake h.p. belt connected to a counter shaft driving a 50 kw., type "A," C.G.E. 1,500 r.p.m., 1154/1040 volt single-phase alternator.

2 Ball Warner arc lamp machines.

They burn some refuse, such as sawdust and cuttings from the planing mill here in addition to coal. The pea coal used for the producer costs them \$1.50 per ton. The slack coal used for engines and pumps costs \$3.00 per ton.

The switchboard consists of one C.G.E. marble panel and one wooden frame switchboard with old type Royal Electric instruments, etc.

The following industries are located in the town and might use the amounts of power given below:

Crone Brick Works.—This plant has a 30 h.p. boiler, 22 h.p. engine and operates about five months in the year, capacity being 15,000 bricks a day. They could use about 20 h.p. motor output.

Telfer Bros.—Biscuit Manufacturers—could use about 25 h.p. for elevators, etc.

F. W. Bryon.—Planing mill—have two 100 h.p. boilers, one 130 h.p. "Leonard Corliss" engine, and one 25 h.p. engine. They burn approximately 12 carloads of slack per annum at a cost of \$3.00 per ton. Considerable refuse is burnt for which there is a market. They could utilize approximately 100 h.p. motor output.

Collingwood Shipbuilding Co.—Have a boiler capacity of from 400 to 500 h.p., and could utilize from 200 to 250 h.p. motor output.

Imperial Steel and Wire Works.—Have two boilers 12 ft. by 72 in., and one Collingwood No. 7 compound engine, the mill being rope driven. They burn approximately 3,000 tons of coal per annum costing \$2.55 to \$2.85 per ton and operate twenty-four hours a day.

A 54 kw., 125 volt, d.c. Westinghouse Generator is belted to the engine and employed for factory lighting. They could utilize from 100 to 150 h.p. motor output.

Charlton Lumber Co.—Have five 100 h.p. boilers, a 450 h.p. engine, and burn refuse with sawdust, slabs, etc. No demand.

Collingwood Packing Co.—Pork and meat packing—have four 100 h.p. boilers burning $\frac{3}{4}$ lump coal and sawdust. Coal costs \$3.75 per ton. Prime movers consist of one 40 h.p., one 65 h.p., one 100 h.p. and one 220 h.p. engines for operating the refrigerator plant twenty-four hours a day. They burn approximately thirty-two tons a week. However, a large amount of this coal is employed for heating and cooking purposes in the factory.

They state that they could use from 100 to 150 h.p.

Collingwood Milling Co.—Have an 85 h.p. boiler and a 75 h.p. engine. They burn refuse and about four earloads of coal per annum, and operate for about eleven months of the year. They could use from 50 to 75 h.p. motor output.

Burns Manufacturing Co.—Furniture manufacturers—burn part refuse and part coal. They could utilize about 50 h.p. motor output.

Wilson Bros.—Sash, door and hardwood flooring—have two 100 h.p. boilers and refuse. No demand.

Tannery Co.—Have two 50 h.p. boilers and one 35 h.p. engine. They burn slack costing \$3.10 per ton, and consume about fifteen tons a week for twenty-four hour a day. They could use from 40 to 50 h.p. motor output.

Dixon Foundry Co.—Have a 15 h.p. gasoline engine. Could use about 10 h.p. motor output.

Attached hereto is the auditor's report and the By-Laws of the waterworks and electric light plant of the Town of Collingwood, balance and unpaid principal on which is \$69,745.49. The debenture debt is \$168,058.25, local improvements \$102,988.02. They are issuing \$96,500 for 1911.

Thornbury.

Population 800 to 900.

The following industries are located in the town:

Andrew Estate Flour Mill and Parkinson Cereal Co.—These two companies operate their mills from a water power developed on the Beaver River. Water rights, etc., are owned by the Andrew Estate, and supply about a 12 ft. head and an approximate output capacity for ten months in the year of from 100 to 150 h.p. The dam and flume are constructed of timber, and are in need of repair. The Andrews Estate operates a generator, supplying current for street lighting and residences, their agreement for the street lighting being on an annual contract basis, the town paying approximately \$375.00 per annum for nine arc and two or three incandescent lamps, in addition to the lighting of the Town Hall with ten 16 c.p. incandescent lamps. Service is provided from dark to 1 a.m. for residence lighting during the summer months, and in addition throughout the winter months from 5 to 8 a.m. This company also supplies energy for lighting in the Town of Clarksburg, one mile from Thornbury.

Thornbury Transportation and Reduction Co.—(Wood alcohol.) This concern has a large concrete mill located close to the harbour, with approximately 200 h.p. installed boiler capacity. They were bonused by the town with a loan of \$10,000 for a twelve-year period, but the company is not exempt from taxation.

The mill is not operating at present because of the scarcity of wood for process, but will probably start up again this fall. They might possibly be able to use from 75 to 100 h.p. motor output.

Herald Printing Office.—3 h.p. motor output.

Evaporating Company.—75 h.p. motor output.

J. H. Brown.—Baker and confectioner, 5 h.p. motor output.

R. Conn.—Seed merchant, 5 h.p. motor output.

Gilson.—Butcher, 3 h.p. motor output.

T. Idle.—Undertaker, 3 h.p. motor output.

Knetsinger Planing Mill.—Could use 5 h.p. motor output.

The amounts of power which we estimated could be taken by these different towns are tabulated as follows:

Municipality.	h.p.
Mount Forest	100
Harriston	150
Palmerston	250
Listowel	250
Durham	500
Hanover	300
Meaford	250
Thornbury	125
Collingwood	750
Owen Sound	1,200
Shallow Lake	1,000
Wiarton	600
Total	5,475

From this information, a number of estimates were prepared on the cost of supplying power to the district, assuming different sources of supply, various transmission voltages, and different combinations of load.

Considerable time was spent on this work, since the district is large and the distances of transmission were too great for the ordinary voltages in use. Special standards also had to be designed for the work, so that it is really impossible to fully explain the mass of detailed labor which these estimates required.

It is, therefore, necessary for the municipalities to co-operate and take united action to provide for a distribution system. It was suggested that the municipalities vote on by-laws at the Municipal Elections in 1912. Probably the majority of them will follow this suggestion.

Eastern Municipalities.

As a result of considerable agitation relative to supplying power to this district, a meeting was held in Brockville on December 14th, 1910, and attended by representatives from municipalities situated between Napanee and Morrisburg as well as by a representative of the Commission. A resolution was unanimously passed requesting the Commission to submit estimates on the cost of power in the following amounts:

Napanee	200	h.p. to	300	h.p.
Kingston	1,200	"	1,800	"
Lansdowne	100	"	150	"
Brockville	1,000	"	1,500	"
Lyn	150	"	225	"
Prescott	500	"	750	"
Cardinal	100	"	150	"
Morrisburg	2,000	"	3,000	"
Athens	75	"	100	"

Previous to this, requests for estimates had been received from several of these municipalities, but due to the lack of co-operation no satisfactory method of supply could be developed for them. Steps were also taken at this meeting to form an active union so that the matter might be forwarded and the power demands of that district supplied at the earliest possible date.

A number of estimates were accordingly prepared for supply power from a development at Waddington, N.Y., with which the Commission had secured an optional contract.

During the summer, engineers spent several weeks investigating the conditions in the district, and from their reports we found that the municipalities could safely figure on the following amounts of power for immediate use:—

Morrisburg	1,500 h.p.
Brockville	750 "
Prescott	500 "
Kingston	2,500 "
Gananoque	Uncertain, owing to water power.
Lyn	150 "
Athens	50 "
Lansdowne	50 "
Napanee	250 "

The other municipalities in the district require so little power that their demands may be properly classed as a "Rural Demand."

A number of possible methods to provide for the transmission and supply of power from other localities were also considered at the same time and many prospective consumers were interviewed in order that a basis might be arrived at on which estimates of the cost of supplying power could be drawn up. The opinions of different citizens of the municipalities were obtained in order to definitely determine whether or not the demand which existed was occasioned by both light and power users or only those requiring power. We found, however, that the demand was common to all, and as a rule, all desired to improve the commercial conditions in the towns by securing an ample supply of cheap power

The eastern municipalities, with the exception of Napanee, were strongly in favor of purchasing power from the Hydro-Electric Power Commission. The latter alone accepted an offer from a private corporation for their municipal lighting plant, and gave this corporation a franchise for the distribution of light and power in the town. Kingston was also made a similar offer by the same company, and their consideration of this offer, together with their inclination to compare the advantages of a commercial proposition with those of a municipal department, caused considerable delay in the negotiations with the other towns. However, revised estimates were prepared from which some of the municipalities were omitted, and sent forward, together with a blank form of by-law enabling the councils to contract for power on October 19th, to the municipalities mentioned below:—

Municipality.	H.P.	Cap. Cost per H.P.	Cost of Power plus Administration, plus Operation, plus Lost Power.	Plus Interest, 4 per cent.	Plus Maint., 1 per cent.	Plus Sinking Fund, 1.8 per cent.	Plus Deprecia- tion.
Kingston	3,000	\$127.86	\$19.00	\$24.11	\$25.39	\$27.69	\$30.25
Brockville	750	75.60	17.83	20.85	21.61	22.97	24.48
Lyn	150	158.10	20.34	26.66	28.24	31.09	34.25
Morrisburg	1,200	4.33	12.69	12.86	12.90	12.98	13.07
Cardinal	100	68.78	14.82	17.57	18.26	19.50	20.88
Prescott	200	151.32	17.40	23.45	24.96	27.69	30.72
Total	5,400						

Municipality.	H P.	Cap. Cost per H.P.	Cost of Power plus Administration, plus Operation, plus Lost Power.	Plus Interest, 4 per cent.	Plus Maint., 1 per cent.	Plus Sinking Fund 1.8 per cent.	Plus Deprecia- tion.
Kingston	4,000	98.47	16.17	20.11	21.09	22.86	24.83
Brockville	1,100	54.91	16.05	18.25	18.80	19.79	20.89
Lyn	200	116.81	18.00	22.67	23.84	25.94	28.28
Morrisburg	1,400	3.90	12.17	12.33	12.37	12.44	12.52
Cardinal	150	48.90	13.65	15.61	16.10	16.98	17.96
Prescott	300	103.92	15.50	19.66	20.70	22.57	24.65
Total	7,150						
Kingston	5,000	81.38	15.03	18.29	19.10	20.56	22.19
Brockville	1,500	42.88	14.72	16.44	16.87	17.74	18.60
Lyn	250	92.40	16.31	20.03	20.96	22.61	24.46
Morrisburg	1,600	3.41	11.66	11.80	11.83	11.89	11.97
Cardinal	200	36.75	12.89	14.36	14.73	15.39	16.12
Prescott	400	78.02	14.40	17.52	18.30	19.70	21.20
Total	8,950						
Kingston	7,500	58.73	13.91	16.26	16.85	17.91	19.08
Brockville	1,500	36.70	14.10	15.57	15.94	16.60	17.33
Lyn	250	86.22	15.68	19.13	19.99	21.54	23.27
Morrisburg	1,600	3.41	11.16	11.30	11.33	11.39	11.46
Cardinal	200	36.75	12.37	13.84	14.21	14.87	15.60
Prescott	400	78.02	13.86	16.98	17.76	19.16	20.72
Total	11,450						
Kingston	10,000	48.76	13.51	15.46	15.95	16.83	17.80
Brockville	1,500	33.82	13.98	15.33	15.67	16.28	16.95
Lyn	250	83.34	15.58	18.91	19.74	21.24	22.91
Morrisburg	1,600	3.41	11.16	11.30	11.38	11.39	11.46
Cardinal	200	36.75	12.37	13.84	14.21	14.87	15.60
Prescott	400	78.02	13.86	16.98	17.76	19.16	20.72
Total	13,950						

Elmvale.

A resolution was received from Elmvale on June 13th, 1911, requesting an estimate on the cost of supplying them with 100 h.p. from the plant of the Simcoe Railway and Power Company.

A number of estimates were prepared on the cost of supplying 2,200 volt power, constructing a sub-station and installing the necessary equipment.

Elora.

See Report on Fergus.

Fergus.

A request for an estimate on a supply of power from Guelph was received from the Town of Fergus on January 2nd, 1911. An engineer visited the town to investigate their power requirements, and found that a demand existed there for about

200 h.p. We advised the Mayor of Fergus on April 14th that our estimated cost for this amount of power was \$35.25 per h.p. per year for Fergus and Elora, assuming that Fergus would take 200 h.p., and Elora 150 h.p. On April 21st, a request was received from the Clerk of the town asking for an explanation of the manner in which this estimate had been drawn up. An explanation was submitted on April 26th.

Galt.

At the request of the Town of Galt, an engineer having no connection with the Hydro-Electric Power Commission made a valuation of the plant and equipment of the Galt Gas Lighting Company prior to its purchase by the town. The details of this valuation were examined by an engineer of the Commission, and several visits were made to the town to assist in the negotiations. Arrangements were finally made whereby the town agreed to purchase the poles and wires from the company.

Our Engineering Department was appointed consulting engineer for the town in connection with the recently purchased system and its adaption to Hydro-Electric power on April 14th, 1910. Our engineer later visited the town to make a careful study of their requirements relative to the distribution of energy for power and light, street lighting, and the water works system.

Specifications were prepared for three 150-kv-a. transformers, the necessary switching and line protective equipment and three series street-lighting equipments with a capacity of two hundred lights each.

After tenders had been received for this material, they were compared in detail, recommendations made, and contracts awarded for the supply of the three transformers to the Packard Electric Company, the line protection and the street lighting equipment to the Canadian General Electric Company, and switching equipment to the Canadian Westinghouse Company.

Advice regarding the arrangement of this equipment in a building supplied by the town was given, and plans prepared covering the complete layout. During the installation of the apparatus our representative visited Galt at regular intervals to supervise the work and give whatever instructions were necessary. Reports on the progress of construction as well as plans for the power distributing and street lighting system were supplied to the local superintendent, together with the necessary instructions.

After the equipment had been installed, a careful inspection was made of the entire layout. Power was first supplied to Galt on March 15th, 1911, their load during the first month of operation being 80 h.p., and for the last current month 335 h.p.

The subject of the rates to be charged by the town for energy utilized for power and light was carefully investigated and the standard schedule finally recommended. Our representative now visits the town at least once a week, and, while there, is at the service of the municipality to give advice on any engineering problems that may present themselves in connection with their distribution system or the sale of power. He also visits prospective power consumers for the purpose of discussing with and explaining to them the system of charges employed, and is furthermore expected to go into the details with customers regarding methods of driving their machinery, etc., and whatever additional information they may need.

A great deal of soliciting for customers has been done for the town, and the increased power load in Galt is very satisfactory.

Gananoque.

See Report on Eastern Municipalities.

Georgetown.

The power demands of Georgetown were investigated in connection with those of Acton and Rockwood, and some time was spent by our engineer in ascertaining the requirements of the former. No action was taken by the municipality.

Goderich.

The Secretary of the Board of Trade of Goderich requested on December 5th, 1910, a report on the estimated cost of development and the probable amount of power which could be developed on the Maitland River near Goderich. Final action was taken by the Council of Goderich on January 20th, 1911, when formal estimates were requested. Engineers were, therefore, sent to Goderich to investigate the probable power load, the power in use in Goderich and the surrounding district, possible power sites, etc., and also prepare estimates on the cost of development. The report on the power development will be found in the report of the Hydraulic Department.

It was found that the probable load in Clinton would be 250 to 400 h.p., and in Goderich from 300 to 500 h.p.

A large number of estimates was prepared on the assumption of supplying them with power developed on the Maitland River and tying in this system with the Niagara system by a line through Stratford, so that power could be supplied from the latter during periods of low water on the Maitland River. However, owing to the necessity of securing gauge readings on the river during the various seasons of the year, this information is not, as yet, available for the municipalities interested.

The Huron County Council was also very much interested in the proposed development on the Maitland River, and suggested that the County develop this power and transmit it throughout the district. In order to determine the probable demand of this section, an engineer visited all of the municipalities and investigated power conditions in each. The data secured are given in the Huron County Report.

Grantham.

See Report on Rural Distribution.

Grimsby.

See Report on St. Ann's District.

Guelph.

Although the City of Guelph has its own staff of engineers to supervise the installation of the electrical equipment and distributing system, nevertheless the specifications for all apparatus operating on Hydro-Electric power were carefully examined and approved by the Engineering Department of the Commission before contracts were awarded.

Arrangements were also made whereby the city were permitted to install part of their apparatus in the Commission's transformer station, an arrangement which

resulted in a saving in equipment and number of operators as well as making unnecessary the construction of a special building to house this apparatus. Various supplies required in connection with their distributing system, such as poles, wire, insulators, etc., were purchased from the dealers, by the Commission, for the Board of Light and Heat Commissioners, at a reduced price.

After the city's equipment had been installed, a careful inspection was made of the layout prior to the delivery of power, which was first supplied Guelph on November 13th, 1910. The maximum load taken during the first month of operation was 248 h.p., and for the last current month 898 h.p.

Guelph Agricultural College.

See Department of Public Works.

Hamilton.

Under the original special agreement with the City of Hamilton for 1,000 h.p., the city agreed to act as a customer and not as a full partner with the other municipalities.

On July 25th, 1911, in the face of great opposition, a by-law was passed by the ratepayers of Hamilton authorizing the Council to enter into a new contract with the Commission, whereby the City of Hamilton should enjoy full privileges with the other municipalities. A Money By-law was also passed at the same time authorizing the city to issue debentures to the amount of \$500,000.00 to cover the cost of a municipal distributing system, the construction of which is now under way, a new contract having been signed.

The rates used are similar to the standard schedule with slight modifications. Contracts are now being made with power-users, and there are good prospects for a large demand in Hamilton.

Hamilton Asylum.

See Department of Public Works.

Hanover.

See Report on Durham District.

Harriston.

See Report on Durham District.

Hespeler.

The Engineering Department, acting in the capacity of consulting engineer, sent a representative to Hespeler in December, 1909, to investigate the local conditions, and secure the necessary information for an estimate on a transforming and distributing system.

From the data obtained, specifications were prepared for three 100 kv-a. single phase transformers 13,200/6,600/2,200 volts, one 85 kv-a. synchronous motor and the necessary switching equipment for their operation and control. The specifications were submitted to the town for their approval, after which, on January 4th, they were sent to various manufacturers who desired to tender on the items. The tenders, when received, were compared and forwarded to the Chairman of Fire and Light Committee with our recommendations. The contract was finally awarded to the Canadian General Electric Company.

The specifications of material for the distributing system were also referred to our engineers, and recommendations made in accordance with which supplies were purchased. The installation of the sub-station equipment was under our supervision, and the entire layout given a thorough inspection prior to being placed in operation.

Power was first received in Hespeler on January 15th, 1911. The maximum amount taken during the first month of operation was 87 h.p., while during the month of October their maximum load reached 101 h.p.

Our engineer visits Hespeler once a week, and during these visits is at the service of the Fire and Light Committee to suggest a solution for any engineering problems which may arise. He also interviews prospective power-users, and explains to them the details of the charging system, makes recommendations regarding the customers' drive, and if necessary, makes suggestions in connection with extension of the distributing system, as well as taking care of any other details that may arise.

High Falls Distribution.

At the time we investigated the possible methods of supplying the municipalities situated between Napanee and Morrisburg, (See Report on Eastern Municipalities) it was thought advisable to report on the possible supply of power from High Falls near Calabogie to Kingston and the eastern Municipalities.

The district through which the line might be built was surveyed and our engineer spent considerable time investigating conditions in the different municipalities including the mines adjacent to these municipalities. The result of these investigations is given in the following report:—

REPORT OF KINGSTON AND DISTRICT NORTH TO CALABOGIE.

On Monday June 26th, I arrived in Kingston and proceeded to investigate industrial needs, etc., in the districts north of here as far as Calabogie, that might be supplied from the development at High Falls on the Madawaska River. The following places were visited, and conditions found to be as follows:—

Harrowsmith.

Population 400 to 500; 125 houses, four stores, one bank, one hotel, K. & P. Railway and G. U. Railway. The industries here are as follows.—

W. J. Camsill. Sawmill and Cheese Box Maker. The output of this factory is 200 to 300 boxes per day, factory operates ten hours per day seven months in the year. At present there is installed a 25 h.p. boiler and a 25 h.p. engine. Refuse from the factory is utilized as fuel. A 25 h.p. motor might be installed.

A. Brassau. Cheese Factory. This factory is operated by a steam power plant, having a capacity of 25 h.p. Steam is required here for process. The factory operates ten hours per day eight months of the year. They could employ a 5 h.p. motor in this factory.

J. S. Gallagher. Feed Mill. The power used here is supplied by a 15 h.p. gasoline engine operating five hours per day eight months of the year. A motor of 7 h.p. could be used.

The village itself could utilize about three hundred incandescent lights for residence and street lighting purposes. The total probable load for the village covering the lighting and power requirements would be about 42 h.p.

Sydenham.

Population 600. A meeting was held in this village and attended by the Reeve, the Council of the township, consisting of five members and four business men.

The industrial conditions here are as follows:—

The Woodruff Sawmill and Feed Mill. Manufacturers of Flour, etc. This company owns and operates a development at the outlet of Sydenham Lake, with a fourteen foot head, driving three 24 in. Samson-Leffell wheels operating the feed mill, and one 36 in. Giant Wheel operating the sawmill. The head works are constructed of timber and are in need of repair. It is probable that a development to provide 60 h.p. throughout the year could be made here. Water rights however, are held by the Woodruff Estate, and cannot be disposed of before the end of the present year.

Birch Lake Mining Co. This company operates a mica mine four miles from the village. Their present power plant consists of a 20 h.p. steam installation. They could use approximately 10 h.p. motor output in addition to about 50 incandescent lights.

Loughboro Mining Company. This company operates a mica mine three and one-half miles from the village. Their power plant consists of two 80 h.p. boilers (140 h.p. required in the summer), one eight drill compressor, and a hoist elevator of 20 h.p. capacity. The output of this mine is about 8,000 pounds per week, 40 men being employed. Their cleaning plant, etc., is located in Ottawa. The former plant operates ten hours per day twelve months of the year. Electrical power might be employed for lighting purposes only, since the steam plant is required for heating drills, etc. Three or four hundred lamps, however, might be used in the factory, and about five hundred in the village. The requirements here are about 60 h.p.

We are told that cheap power would give impetus to the further development of the present mines as well as the operation of other mines in that immediate district.

Yarker.

Population 300. Two companies supply power for lighting to the village, but have no arrangement with the township, and place the poles and lines where they choose. They own and operate a water power consisting of two plants located on opposite sides of Napanee River. The generating capacity of each plant is about 15 h.p. Energy is generated at 110 volts d.c. The principal industry is J. Wright's factory and carpenter shop, employing water power purchased from one of the above companies, which could use about 10 h.p. of motor output. For street and house lighting within the village about 30 h.p. would be required, making a total demand for the municipality of about 40 h.p.

The Napanee River Improvement Company practically controls the flow of the Napanee River by a system of reservoirs in the Townships of Hinchinbrooke and Portland. Each water-right holder is interested and practically a shareholder in above company. It is reported that the interests of this company are to be taken over in the near future by an electric development company operating in this section.

Napanee.

Population 3,500. The town owns and operates its electric plant, steam power being used. The plant was built in 1905, and consists of the following

property, Real Estate, 66 ft. by 200 ft.; a one-storey stone and concrete building 35 ft. by 75 ft.; two 18 ft. by 72 in. Robb Armstrong boilers; two 16 in. by 20 in. 150 r.p.m. Robb Armstrong engines belted to two Allis Chalmers Bullock, 125 k.w., 2,300 volt generators; a four panel switchboard, two Adams Bagual constant current regulators, 2,500 volt 60 cycles, 6.6 amperes, operating thirty-eight arc and thirty 60-watt series Tungsten Lamps. The plant also supplies lighting service from sunset to sunrise to two hundred and seventy-five customers.

The industries in Napanee are as follows:—

Dominion Rock Drill Company. The power plant has a capacity of 50 h.p. generated by steam; the plant operating continuously ten hours per day. At the present time, 30 h.p. could be utilized, which in time, might be increased to about 50 h.p.

Craig Feed Mill. The power equipment consists of a 45 h.p. Fairbank's Gas Producer equipment which is operated ten hours per day for nine months of the year. This plant has been in operation less than twelve months.

R. Light. Sawmill. This plant is operated by a 40 h.p. engine and a 50 h.p. boiler; refuse from the mill is used for fuel. This refuse could be marketed to advantage, although some steam is required for heating purposes in the mill. A load of about 15 h.p. for an eight hour service for twelve months of the year could be employed.

Napanee Canning Company (Merged with the Dominion Canning Company). This company requires approximately 60 h.p. from nine to ten hours per day during five months of the year. Heat is required for cooking, etc. About 20 h.p. could be used here during three or four months of the year.

From these data, we found that a total load of about 135 h.p. is at present required, which could be easily increased to 250 h.p.

Verona.

Population 150 to 200. At the present time there is one mine, producing felspar, in operation about two and one-half miles west of the village. A 25 h.p. steam plant is employed which operates ten hours a day throughout the year. They plan to increase their capacity to 60 h.p. in the near future.

The "Big Mine" located at Dessert Lake, also a felspar proposition, has a 75 h.p. steam installation. This mine is seven miles from Verona. Both of these mines are owned and operated by the same company and could at present utilize approximately 50 h.p.

Sharbot Lake.

Population 300. The only industry located here is one sawmill with a 35 h.p. steam installation. There is practically no demand for electrical energy.

Wilbur.

The Exploration Syndicate, Limited, are operating a magnetite mine here and have installed a steam plant of 150 h.p. capacity. Wood is used principally as fuel at a cost of \$2.00 per cord. The mine is in the developing stage, and at the present time, could use approximately 50 to 75 h.p.

Folger.

The principal industry of the village is Lawrence Bros. Sawmills. Their existing power installation consists of four 80 h.p. boilers and two engines. It is

quite probable that from 50 to 75 h.p. could be used here now and a still greater amount when additions are made to the plant. The street lighting load of the village would be very small, from 50 to 75 incandescent lamps being required at the most. For the present requirements 50 h.p. may be safely considered necessary.

Calabogie.

The industries here are as follows:—

Carswell Company. Sawmill Operators. This mill has a steam installation of approximately 150 h.p. capacity. It has not, however, been operated for the past three or four years. The owners stated that with the introduction of cheap power, the mill would again be placed in operation and that about 100 h.p. motor output would be employed.

Mr. T. J. Colwell. Has three mines that are being developed near Calabogie, which could utilize about 300 h.p.

Black-Donald Graphite Company. This company has been in operation for the past eight or nine years, and is situated fourteen miles from Calabogie. They develop power at a mountain chute on the Madawaska. The plant now in operation has a capacity of 600 h.p., and there is still sufficient surplus power available there to provide for any extension they may make. In addition to graphite, iron ore, marble and copper are being mined to some extent.

The present demands require at least 400 h.p.

Smith's Falls.

The industries here may be described as follows:—

Frost and Wood. Manufacturers of Agricultural Implements. Have a steam plant of 500 h.p. capacity, and burn 2,200 tons of coal a year at \$4.34 per ton. The plant operates ten hours per day, and the company estimate that their steam power costs them at the rate of \$40.00 per h.p. per year. In the event of cheap electrical power being available, they would be in the market for from 350 to 400 h.p.

Smith's Falls Malleable Company. This company has a steam and water power plant. They control the Smith's Falls Electric Light and Power Company, which has a five year agreement for street lighting with the town, with sixty-eight arc lamps at \$58.00 per year each. They have no franchise or agreement for supplying energy for incandescent lighting, but have erected poles and wires throughout the town, and are selling energy at arbitrary prices, no fixed rate being employed. Twenty-four hour service is supplied when possible. The maximum load is approximately 175 h.p. and the average load throughout the summer months about 75 h.p. The company has been in operation for about eighteen years.

The Citizen's Electric Light Company. These people also supply power for incandescent lighting from their distributing system in opposition to the Smith's Falls Electric Light and Power Company. The former company owns and operates a water power derived from the surplus water of the canal; a steam auxiliary being used during low water seasons. The latter has no franchise with the town.

The Water Works System is owned and operated by the Town of Smith's Falls, and consists of a 50 h.p. 500 volt motor direct connected to a No. 5 J. McDougall turbine, seldom used. They also have one "Deane" steam pump. The water capacity is approximately 100 h.p. Steam pressure, through the consumption of from one and one-half to three tons of coal per day, is maintained for fire protection. In addition to the electric and steam plant, they also have a water

power equipment consisting of a Leffel, 40 in. wheel, direct connected with a triplex "Deane" pump. All this apparatus is contained within the same building, and has been purchased at various times. The town contemplates expending several thousands of dollars to place the water-works system in proper condition. This, however, should not be done until the present and future demands of the town have been considered.

Perrin Plow and Stove Works. The Plow Department of this plant is reported as planning to leave Smith's Falls. The stove works have an option on 22 h.p. which they purchase from the Citizen's Electric Light Company, and employ in addition a 25 h.p. steam equipment of their own.

Canadian Coöperage Company. This company has just started operation and has installed two boilers with an aggregate capacity of 140 h.p. They have a 75 h.p. and a 35 h.p. engine, and burn mill refuse, cuttings, etc., as fuel. This material has a marketable value, and in the event of power being obtainable in the town at a reasonable rate, motors would be installed up to 75 h.p. capacity.

The Woods Milling Company. This company owns and operates water rights on the river, and uses about 250 h.p. At certain seasons of the year they are troubled with low water and could possibly use from 75 to 100 h.p. during these periods.

A meeting was held with the Board of Trade and Town Council, at which the use of Hydro-Electric power was suggested. After a careful consideration of the industrial and lighting demands of the town, it was decided that from 750 to 1,000 h.p. could be utilized, and it was proposed that the Hydro-Electric Power Commission be requested to report on the situation and offer suggestions.

Perth.

The water works and incandescent lighting systems are operated by the Canadian Electric and Water Works Company.

This Company has two water powers on the Tay River, one three and one-half, and the other four miles from Perth. They generate and distribute 133 cycle, two-phase power for lighting to customers within the town, and supply approximately 200 consumers at a rate of 10c. per kilowatt hour. During the summer months their average load is about 75 h.p., and in the winter months it frequently reaches 150 h.p. The water-works system of the town requires an average power load of about 40 h.p. The town provides for arc lighting, and owns and operates a small water power on the Tay River.

A meeting of the Board of Trade and Council was called by the Mayor for the purpose of discussing the power situation, upon which reports have been made by the engineers. As yet, however, no action has been taken to reach an understanding between the town and the company.

Other industries in the town are as follows:—

Perth Woolen Mills.—This Company has a steam plant of 150 h.p. capacity driving their woolen and felt mill. They consume 1,000 tons of coal per year at a cost of \$4.57 per ton, with the plant operating ten hours per day for five and one-half days of the week. Although a certain amount of steam would be required in the mill for heating and dyeing purposes, about 80 h.p. motor output could be installed.

Kippan.—A saw mill having a 70 h.p. boiler and a 60 h.p. engine and burning refuse and cuttings for fuel. The refuse and cuttings possess marketable value, and, in the event of cheap power being supplied, motors could be installed with a capacity of from 25 to 35 h.p.

Wind Shoe Company.—This Company has just started to operate, and have installed a gas producer plant of 50 h.p. capacity, which they consider sufficient to meet their requirements for a year at least.

Henry K. Wampole Company—manufacturing chemists—have an installed boiler capacity of 150 h.p. and a 100 h.p. engine. A 30 kw. 125 volt D.C. generator is connected to this engine and employed for factory lighting in addition to the other power required. The Company say that actual tests have shown their average load to be about 35 h.p. except in the winter months when steam is also used for heating purposes and power is required to drive the generator for the factory lamps. They have about 250 incandescent lights installed in the factory.

James and Reid.—This Company operates a factory and machine shop by a 15 h.p. gasoline engine and a 25 h.p. steam equipment. Were cheap power available, motors with an output of 25 h.p. could be installed.

Dittrick Bros.—This company operates a machine shop, and in the event of electric power being supplied the town can install a 10 h.p. motor.

Dodds Carpet Company of Guelph.—This Company has made excavations for a small plant at Perth. The amount of power that will be required has not been determined. The town decided at a meeting that they could use 150 h.p., and if satisfactory arrangements could be made between the town and the Electric Light and Water Works Co. whereby the town could purchase them, the power demand could be increased to 300 h.p.

The present aggregate demand of the Town of Perth may safely be considered as 250 h.p.

The estimated demand resulting from these surveys is as follows:—

Kingston	2,400 h.p.
Sydenham	100 "
Harrowsmith	50 "
Yarker	35 "
Napanee	250 "
Marlbank	1,000 "
Verona	100 "
Perth	250 "
Smith's Falls	750 "
Lanark	50 "
Carlton Place	100 "
Almonte	50 "
Wilbur	50 "
Folger	75 "
Calabogie	400 "

A number of estimates have been prepared, on different schemes and routes, for transmission lines to supply this district with energy.

Ingersoll.

Although a contract had been made previous to October 31st, 1909, between Ingersoll and the Commission, for power, no further action was taken until Nov. 17th, 1910. when a request was received from the Town of Ingersoll asking that an engineer be sent to attend a meeting held to discuss the local electrical situation.

On February 1st, 1910, a deputation from Ingersoll interviewed the Engineering Department relative to the cost of power, and the system of charging employed for municipalities was explained to them.

Messrs. Ross and Holgate of Montreal, were appointed as Consulting Engineers for the town, to supervise the installation of their step-down transformer

equipment. Later, they withdrew, after contracts covering the apparatus had been awarded, and the Engineering Department of the Commission was appointed in their stead to supervise the construction of the municipal sub-station building and the installation of the transformer and switching equipment.

At the January, 1911, municipal elections, a by-law was passed creating a Commission to manage the Electric Light and Power Department. The Chairman of this new Commission wrote our Engineering Department for instructions regarding the work at hand, and an engineer was sent to Ingersoll who familiarized them with various details of management. After the installation had been completed a careful inspection was made of the layout.

Power was first delivered to Ingersoll on April 1st, 1911, the maximum load for the first month of operation being 167.7 h.p., and for October, 1911, 201 h.p.

The schedule of rates which the town employs was submitted to the Commission for their approval. Our engineer visits the town at frequent intervals, and interviews prospective customers in the interests of the local Commission.

Kingston.

A letter asking if the Commission had any other proposition to offer in respect to power, other than those which had been previously made, was received from the Chairman of the Industries Committee of Kingston, in March, 1911.

A number of estimates were prepared on the cost of delivering power to Kingston from a point opposite Waddington, N. Y., and also from High Falls on the Madawaska River. These estimates, however, were not submitted, since it was decided to make a complete study of the power requirements in the district lying north of the St. Lawrence River, so that estimates could be prepared to cover this area. Later, a complete engineering survey was made of this district, and from the information obtained, estimates were prepared (see High Falls, also Eastern Municipalities).

Kingston Asylum.

See Department of Public Works.

Lakefield.

An application was received on January 10th, 1911, from the Village of Lakefield for an estimate on the cost of supplying 400 h.p. to the village. The application has been held pending investigations of conditions in Peterboro (see Hydraulic Report) and an engineer was sent to Lakefield to make an investigation of conditions and place a valuation on the present equipment. The maximum load in Lakefield is about 150 h.p.

Lindsay.

See Hydraulic Report.

Listowel.

An application was received on December 12th, 1910, from the Town of Listowel, for an estimate on the cost of transmitting 300 h.p. to the municipality.

The following estimated costs for transmitting power to Listowel from Stratford, at 26,400 volts, were submitted:

H.P.	Cost per H.P.
400	\$42 14
600	35 14
800	31 65
1,000	29 35

While investigating the possible sources from which to secure a supply of power for Collingwood, Owen Sound, and other points between these places and Guelph and Stratford, our engineer visited Listowel and enquired into the existing conditions. At the present time the town requires approximately 250 h.p. (See Report on Durham District.)

London.

London had contracted for power with the Commission previous to October 31st, 1909. Specifications covering the electrical equipment were later submitted to the Engineering Department of the Commission for approval, previous to awarding the contracts. After the installation of the apparatus a careful inspection was made before power was delivered.

At the request of the Water Commissioners a number of prospective power consumers were interviewed, and the rates which were to be employed were explained to them by an engineer of the Commission.

Power was first received in London on December 2nd, 1910. Their maximum load during the first month of operation was 805 h.p., and for October, 1911, 1,609 h.p.

London Asylum.

See Department of Public Works.

Lucan.

The Secretary of the Board of Trade of the Town of Lucan requested that an estimate on the cost of transmitting 500 h.p. to that municipality be submitted, and after careful investigation this was forwarded on November 23rd, 1909, for 500 h.p. at 13,200 volts at \$34.00 per h.p. per year from the London Station.

Markham Village.

A resolution was received from the Council of Markham Village in July, 1911, requesting the Commission to submit an estimate on the cost of supplying power to the village. An engineer of the Commission paid a visit there on October 5th, and obtained the data required for the preparation of the estimate required.

The village requested us on October 25th to secure quotations on material for a new street lighting system. Information was obtained and sent to Markham on October 31st and December 8th.

Meaford.

See Report on Durham District.

Middleton Township.

Numerous inquiries had been received from residents of Middleton Township and the vicinity of Courtland regarding Hydro-Electric power, and on January 24th, 1911, an engineer was sent to Tillsonburg to meet and explain to those living in the rural district adjacent to Tillsonburg the procedure to be followed to obtain an estimate on the cost of supplying them with power. Two days later an application was received from the Clerk of Middleton Township for an estimate on the cost of supplying power to this neighbourhood.

Action relative to the Power Commission Act of 1911 was pending at the time this application was made, and the matter was therefore held so that the parties interested might secure the benefit of this action. We were advised on June 6th that the Township had received a petition signed by twelve farmers in accordance with this new Act. During the last week in July an engineer visited Tillsonburg to investigate conditions for the purpose of drawing up an estimate.

The Clerk of the Township forwarded a map showing the location of the various petitioners together with an approximate list of power that each would require, and from this information, together with what had previously been secured, estimates were prepared shewing that electrical energy could be supplied at a cost of \$70.00 per h.p. per year.

A meeting was held in Courtland on October 5th, and various details were explained. (See Report on Rural Distribution.)

Midland.

An application was received in September, 1910, from the Town of Midland, for an estimate on the cost of power supplied from the plant of the Simcoe Railway and Power Company. Upon our receipt of this application an engineer was sent to investigate the plant of the Simcoe Railway and Power Company at Big Chute Rapids on the Severn River, and later, an extensive report on the cost of developing power at this site and transmitting it to the Towns of Midland and Penetang was submitted. Several conferences were held between the Commission and the Town Council of Midland regarding a supply of Hydro-Electric power to the town, and an agreement was finally made by which the Commission agreed to purchase power from the Simcoe Railway & Power Company and deliver to Midland at the corporate limits of the town at 2,200 volts.

At the request of the town, estimates were prepared on the cost of replacing their arc with series Tungsten incandescent lamps, and of a distributing system necessary to provide for power and light. These were submitted to Midland on March 25th.

SUMMARY OF ESTIMATE FOR MIDLAND.

	Capital Cost.	Depreciation.
New Lines and adding Third Wire to Present Primaries	\$3,812 00	\$118 00
New Transformers	1,999 00	126 00
Recalibrating Meters	816 00	65 00
New Street Lighting	1,851 00	98 00
Motor-driven Pump	2,400 00	144 00
Total	\$10,878 00	\$551 00
Engineering and Contingencies, 10%	1,088 00	55 00
	\$11,966 00	\$606 00
Interest during Construction, 2%	239 00	14 00
	\$12,205 00	\$620 00

Annual Charges:—

Annual Interest at 4.5%	\$549 00
Depreciation	620 00
Sinking Fund at 3.36%	410 00
Operating and Administration	1,500 00
Total Annual Charges	\$3,079 00

Later, upon the request of the town, specifications were prepared and tenders received for service transformers and station equipment.

Specifications were also prepared and tenders, received at the request of the Water Department, for a pump capable of discharging 600 Imperial gallons per minute against a 300 foot head, direct connected to a 2,200 volt induction motor.

The Commission recommended the acceptance of the tender submitted by the Canada Foundry Company for a pump of the Mather & Platt design equipped with a Canadian General Electric motor. This recommendation was accepted by the corporation and the pump purchased.

The Corporation requested that power be supplied them for celebration purposes on Coronation Day, and power was therefore first delivered on that date to the town.

Millbank.

A letter was received from Millbank in December, 1910, requesting information regarding Hydro-Electric power. Blank forms of resolution were sent them with the request that they be filled out in the usual way and returned to the Commission.

Millgrove.

A letter was received in October, 1910, from a resident of Millgrove asking for information regarding Hydro-Electric power. Information was furnished.

Milton.

One of our engineers visited Milton on December 1st, 1909. Estimates were prepared and submitted for alternative distributing systems on December 9th. A revised estimate was also submitted on the cost of supplying Milton in conjunction with Brampton. No further action has been taken by the town.

ESTIMATE OF COST OF DISTRIBUTING STATION EQUIPMENT AT MILTON.
(450 kw. capacity.)

Item.	Capital Cost.	Per Cent.	Annual Charges.
1 13,200 volt line entrance lighting arrester, choke coils, panel instruments, oil switch	\$2,800	6	\$168
3 150 kw. 13,200/2,200 volt transformers O.L.S.C. at \$1,125.....	3,375	6	203
2 Feeder panels at \$400.....	800	6	48
1 C.C. transformer for 200-50 Watt series tungstens.....	900	6	54
1 street lighting panel.....	200	6	12
	\$8,075	.....	485
Engineering and contingencies, 10 per cent.	808	.....	49
	\$8,883	.....	.....
Interest during construction, 1½ per cent.....	133	6	8
Total capital cost	\$9,016	.....	.....

ESTIMATE OF COST OF DISTRIBUTING STATION EQUIPMENT AT MILTON.—Continued.
(450 kw. capacity.)

Items.	Capital Cost.	Per Cent.	Annual Charges.
Depreciation .....	.....	.....	542
Interest, 4 per cent. Sinking Fund, 1-8 per cent. on \$9,016.00...	.....	.....	523
Lost power, 5 per cent. at \$35 (300 h.p.) .....	.....	.....	525
Total annual charges .....	.....	.....	\$1,590
Amount of h.p. taken	300	400	500
Total annual charges	\$1,590	1,765	1,940
Annual charges per h.p.....	5.30	4.41	3.88
Total annual charges for power.....	\$1,060	\$1,177	\$1,294
Annual charge per h.p. for power.....	3.53	2.94	2.59
Total annual charge for house lighting	265	294	324
Annual charge per h.p. for house lighting.....	5.30	4.41	3.90
Total annual charge for street lighting.....	265	294	324
Annual charge per lamp.....	1.77	1.96	2.16

ESTIMATE ON COST OF POWER DISTRIBUTION SYSTEM FOR MILTON.
(100 h.p., 2,200 ft. and 7,900 ft., 2,200 volt, single circuit, 120 foot spacing.)

Item.	Capital Cost.	Per Cent.	Annual Charges.
85 poles, with cross arms, at \$11.00	\$935	8	\$75
281 insulators, with pins, at 25c.	70	6	4
9,767 lb. No. 1 W.P. copper at 20c. erected	1,953	2	39
Extra line hardware	150	6	9
2 Watt meters at \$65.00.....	130	6	8
.....	3,238	.....	.....
Engineering and contingencies, 10 per cent.....	324	.....	14
.....	3,562	.....	.....
Interest during construction, 1½ per cent.	53	6	3
Total capital cost.....	3,615	.....	.....
Depreciation .....	.....	.....	152
Interest, 4 per cent.; sinking fund, 1.8 per cent. on \$3,615.00 ..	.....	.....	210
Labor, 1 man at \$60 (¼ time) .....	.....	.....	180
Total annual charges.....	.....	.....	542
Total h.p. taken for power (2/3 of total power taken).....	200	267	334
Annual charges per h.p.	2.71	\$2.03	\$1.62
Station annual charges per h.p.....	3.53	2.94	2.59
Total for power	\$6.24	\$4.97	\$4.21

No transformers are included in the above, but new poles and lines material entirely.

ESTIMATE ON COST OF LIGHTING DISTRIBUTION SYSTEM FOR MILTON.

4,200 feet of primary line, using existing pole lines as secondaries, but adding primary wire and one crossarm, etc., per pole, assuming 120 foot spacing.

Item.	Capital Cost.	Per Cent.	Annual Charges.
35 Cross arms, with insulators erected complete, at \$1.50...	\$53	8	\$4
1,411 lb. No. 6 copper T.B.W.P. erected at 20c.	282	2	6
65 Watt meters erected at \$15.00.....	975	6	59
7 10 kw. 2,200/110 volt transformers erected at \$200	1,400	6	84
	2,710	.....	153
Engineering and contingencies, 10 per cent.....	271	.....	15
	2,981	.....	.....
Interest during construction, 1½ per cent.	45	6	3
Total capital cost.....	\$3,026	.....	.....
Depreciation .....	.....	.....	171
Interest at 4 per cent.; sinking fund, 1.8 per cent. on \$3,026.00	.....	.....	176
Labor, 1 man at \$60 (½ time).....	.....	.....	360
Total annual charges.....	.....	.....	707
H.P. taken for house lighting (1/3 of total power, less power for street lighting)	90	123	156
Annual charges per h.p.....	7.86	5.75	4.53
Station annual charges per h.p.....	5.30	4.41	3.90
	\$13.16	\$10.16	\$8.43

ESTIMATES.—STREET LIGHTING FOR MILTON.

(150 4 ampere, 50 watt Tungsten lamps, and 6 miles single wire.)

Item.	Capital Cost.	Per Cent.	Annual Charges.
150 Brackets, sockets and shades, erected complete at \$10.00..	\$1,500	6	\$90
3,486 lb. No. 6 T.B.W.P. copper wire erected at 20c.....	697	2	14
Extra cross arms and insulator equipment.....	100	6	6
	2,297	.....	110
Engineering and contingencies, 10 per cent.....	230	.....	11
	2,527	.....	.....
Interest during construction, 1½ per cent.....	33	6	2
Total capital cost	2,560	.....	.....
Depreciation .....	.....	.....	123
Interest, 4 per cent.; sinking fund, 1.8 per cent. on \$2,560.00..	.....	.....	149
300 lamps at \$1.00.....	.....	.....	300
Labor, 1 man at \$60.00 (¼ time) .....	.....	.....	180
Total annual charges.....	.....	.....	752
Annual cost per lamp (10 h.p. at \$35.00)—			
Distribution	5.01	5.01	5.01
Station	1.77	1.96	2.16
Power	2.33	2.33	2.33
	\$9.11	\$9.30	\$9.50

NOTE. Interest figures at 4%. Sinking Fund charge is figured at 1.8%, which at 4% interest retires principal in 30 years.

Labor is figured for one man at \$60.00 per month. As no rotating apparatus is included, this man could do all the work and pay his wages by doing wiring in the houses, etc.

MILTON ALTERNATIVE ESTIMATES.

Item.	Capital Cost.	Per Cent.	Annual Charges.
1 13,200 volt line entrance lightning arrester, choke coils, panels, instruments and oil switch	\$2,800	6	\$168
3 100 kw. transformers, 13,200 2,200 volts O.I.S.C., at \$900.00..	2,700	6	162
2 switchboard panels at \$400.00	800	6	48
1 75 kw. motor generator set, 2,200 volt synchronous motor, 220/110 volt, 3 wire generator 750 r.p.m.....	3,800	6	228
	10,100	.....	606
Engineering and contingencies, 10 per cent.	1,010	.....	61
	11,110	.....	.....
Interest during construction, 1½ per cent.	167	6	10
Total capital cost	\$11,277	.....	.....
Depreciation			677
Interest, 4 per cent.; sinking fund, 1.8 per cent. on \$11,277.00..			654
Lost power 10 per cent. at \$35.00 (300 h.p.).....			1,050
Labor, 1 man at \$60			720
			\$3,101
H.P. taken..... 300 400 500			
Annual charges per h.p..... \$10.34 \$7.75 \$6.20			

NOTE. Present distribution system is to be used. No annual charges included outside of station. Two men required. More copper required on lines to provide distribution.

Interest figured at 4%, Sinking Fund charge at 1.8%, which at 4% interest will retire principal in 30 years.

Mimico Village.

A letter was received from the Village of Mimico in April, 1911, asking for particulars relative to a street lighting system. Resolution blanks were sent to the Clerk on May 1st with the request that they be filled out and returned to the Commission. A resolution was received on May 10th for an estimate on the cost of supplying 300 and 400 h.p.

Our engineer was sent to investigate conditions and upon the receipt of his report it was decided that a 13,200 volt line could be built from the Port Credit high tension station near Cooksville, and serve Mimico, Mimico Asylum, and factories located in the vicinity of New Toronto. The probable load for this district was assumed and an estimate prepared on the cost of supplying it with 2,200 volt power.

An estimate was also prepared on the cost of installing a street and house lighting system in the Village of Mimico, the details of which are given below:—

ESTIMATED COST OF DISTRIBUTING SYSTEM IN MIMICO VILLAGE.

	Capital Cost.	Per Cent.	Main. and Dep.
66 40 ft. poles erected at \$8.00	\$528	8	\$42
35 30 " " " " 5.00	175	8	14
200 25 " " " " 4.00	800	8	64
125 54 in. cross arms complete, erected with hardware	125	6	8
250 36 in. " " " " " "	188	6	11
1,000 insulators and pins erected at 25c.	250	6	15
1,250 lb. cable erected at 24c.	300	2	6
9,000 lb. T.B.W.P. copper wire erected at 20c.	1,800	2	36
Guying and bracing	100	6	6
Tree trimming, etc.	300	1½	5
Lightning arresters	200	6	12
4 5 kw. transformers erected at \$90.	360	6	22
2 10 " " for pumping plant at \$125	250	6	15
40 service lines to consumers at \$10.00	400	4	16
40 meters for houses installed at \$12.00	480	6	29
50 street lights and brackets installed at \$8.00	400	6	24
	6,656	.....	325
Engineering and construction, 10 per cent.	666	.....	33
	7,322	.....	353
Interest during construction, 2 per cent.	146	5	7
	\$7,468	.....	365
Operation			300
Renewal of lamps (3 per year at \$1.35)			203
Interest and sinking fund, 6.8 per cent.			508
Power, 20 h.p. at \$31.00			620
			\$1,996

This estimate was submitted to the Council on July 14th, and after considerable delay, two by-laws, reading as follows, were submitted on September 16th:—

Are you in favor of:—

(1) Obtaining from the Hydro-Electric Power Commission of Ontario a supply of electric power?

(2) A by-law to raise \$7,500 by the issue and sale of municipal debentures to install distribution plant for Hydro-Electric power?

The first by-law was carried 97 for and 40 against.

The second by-law was carried 90 for and 45 against.

The Commission submitted a contract for 100 h.p. at \$30.50 per h.p. per annum on October 5th.

It was later decided, at a meeting of the Village Council held on October 14th, 1911, to request the Commission to submit a contract for 50 h.p. A resolution was also passed at this meeting requesting the Commission to act as consulting engineer and purchasing agent, for the village, of all material necessary for the installation of a distributing system in this municipality.

The Commission submitted a contract for 50 h.p. on October 16th for \$30.74 per h.p. per annum. This was signed on October 19th by the Council.

Mimico Asylum.

See Department of Public Works.

Mitchell.

Our engineer visited Mitchell on February 1st, 1910, and with the Mayor, interviewed possible power consumers. An estimate was prepared on the cost of serving Mitchell with 13,200 volt power, and submitted to them on March 26th. Several calls were made by our engineer to the town and on April 22nd, 1910, the chief engineer attended meetings in Mitchell and Seaforth to discuss with them the possibilities of supplying Hydro-Electric power to the district.

A second estimate was prepared on the cost of a distributing system, and submitted on May 25th, 1910. Details of this estimate are given below:—

ESTIMATED COST OF DISTRIBUTING STATION EQUIPMENT AT MITCHELL.

	Capital Cost.	Per Cent.	Annual Charges.
1 3 phase, 13,200 volt line entrance	\$75	.....	.....
1 3 phase electrolytic lightning arrester, complete with horn gap disconnecting switches.....	375	.....	.....
3 choke coils.....	160	.....	.....
3 13,200 volt disconnecting switches.....	75	.....	.....
1 incoming line panel, complete with oil switch and instruments	1,000	.....	.....
3 single phase station transformers, 13,200/550 volt 75 kw. capacity	2,000	.....	.....
Busbars and wiring	50	.....	.....
1 power feeder panel, complete	350	.....	.....
1 syn. motor panel, complete	450	.....	.....
1 pump motor panel, complete.....	250	.....	.....
1 syn. motor, 100 kw. cap., to drive present generator.....	2,100	.....	.....
1 motor and pump, direct connected, for 250 gal. per min. cap. at 60 lb. pressure	575	.....	.....
	7,460	6	\$448
Engineering and contingencies, 10 per cent.....	746	.....	45
	8,206	.....	493
Interest during construction, 2 per cent.	164	6	10
	\$8,370	.....	\$503

ESTIMATED COST OF DISTRIBUTING SYSTEM AT MITCHELL.

	Capital Cost.	Per Cent.	Annual Charges.
Present pole line used.			
Extra cross-arms for 9 poles, complete with hardware, at \$1.00	\$9	6	\$1
266 lb. (2,048 ft.) No. 4 B. & S. copper erected at 20c.	53	2	1
252 lb. (630 ft.) No. 2/0 B. & S. copper erected at 20c.....	51	2	1
Extra line hardware.....	25	6	2
	138	.....	5
Engineering and contingencies, 10 per cent.	14	.....	1
	152	.....	6
Interest during construction, 2 per cent.....	3	.....	.....
	155	.....	6
Cost and charges of station equipment	8,370	.....	503
Total capital cost.....	\$8,525	.....	509
Interest, 5 per cent.; sinking fund, 1.8 per cent.=6.8 per cent...	.....	.....	580
Total annual charges .....	.....	.....	\$1,089

A by-law was submitted to the people on June 17th to determine whether or not they were in favor of Hydro-Electric power, and carried by a large majority. The rate-payers approved a by-law to raise \$9,000 for the construction of a distributing system on November 14th, 1910.

A contract was submitted to the town for 200 h.p. at 38.50 per h.p. per annum on December 5th, 1910, and immediately signed.

At the request of the town, specifications, application for tender, and form of tender were prepared covering the electrical equipment and a pump for their municipal station, and sent to them on January 12th, 1911.

Considerable attention has been given to the adjustment of the power and light rates in Mitchell, and one of our representatives has called at Mitchell at least once a week to give them the necessary assistance in the installation of their plant and canvass of their power customers.

An inspection of the lines and station equipment was made by our operating engineer on August 10th, and a preliminary test performed on the line between Stratford and Mitchell.

Power was delivered to Mitchell on August 10th. In September, 1911, a request was received from Dublin, asking at what date the Commission expected to be in a position to deliver power for lighting the village. An estimate was prepared on the cost of supplying power, this was submitted on October 12th.

Morrisburg.

See Report on Eastern Municipalities.

Morristown.

A request was received from Morristown in November, 1910, for advice as to the procedure to be followed to secure a supply of Hydro-Electric power. The town was supplied with the necessary information.

Mount Brydges.

An estimate was submitted on the cost of supplying power to this village, in April, 1911.

Mount Forest.

See report on Durham district.

Mount Salem.

A request was received from Mount Salem on January 2nd, 1911, for information relative to a supply of Hydro-Electric power for the village. The Town Clerk was notified to have a representative attend a meeting to be held in Tillsonburg on January 24th, to consider the feasibility of supplying energy to the surrounding municipalities.

Napanee.

This municipality requested advice in April, 1910, regarding a contract which they proposed to make with a power transmission company. Subsequent to this, they had considered contracting with the Commission, and had received several estimates on the cost of 13,200 volt power. The town submitted their proposed contract with the power company, to the Commission, and were advised, by a representa-

tive who visited them in July, to postpone action until such a time as the matter could be more thoroughly investigated. However, on June 23rd, 1911, they passed a by-law authorizing an agreement, a franchise, and the sale of the municipal plant to the power company. Several changes, advantageous to the town were later made in this by-law. (See report on Eastern Municipalities.)

Nelson Township.

A request was received from the clerk of Nelson Township in April, 1911, asking for information regarding the procedure necessary to secure Hydro-Electric power, and the probable cost. All available information, together with a copy of the Act of 1911, was supplied the Council.

Newbury.

An estimate was prepared in April, 1911, at the request of the Reeve of the village, on the cost of serving Newbury with 13,200 volt power from the London station.

New Hamburg.

A request was received from New Hamburg in November, 1910, asking that we recommend an engineer capable of making a valuation of their electrical plant, and suggesting changes in detail necessary to adapt this plant for Hydro-Electric power. Recommendations having been made the municipality purchased the private electric light plant and proceeded with the installation of the necessary apparatus and street equipment to render it suitable for Hydro-Electric power. The Commission advised them in the purchase of this apparatus and, on January 26th, 1911, tested their station equipment. They now have very satisfactory service, a load of 107 h.p. and steadily increasing power and lighting demands.

Newmarket.

The Board of Trade in Newmarket requested information relative to a supply of power from the Commission, on May 10th, 1911. Resolution blanks were sent them with the request that the matter be taken up with the Council of the municipality and the customary resolution of Council secured for the Commission. These resolutions were filed in October, and our engineers were then sent to Aurora and Newmarket to investigate conditions.

New Toronto.

Several requests had been received from manufacturers in and around New Toronto for Hydro-Electric power, and our engineer was, therefore, sent to investigate conditions in this district in conjunction with those at Mimico and Mimico Asylum. Manufacturers were visited and an estimate was prepared on the cost of transmitting 500 and 600 h.p. at 13,200 volts along the Lake Shore Road to a station near New Toronto, and there stepping it down to 2,200 volts. Considerable correspondence passed between the manufacturers and the Commission and prices were finally submitted for 2,200 volt power. Subsequently, petitions, which included both the Lake View and Toronto Golf Clubs, were also received, for a supply of power, from both Etobicoke and Toronto Townships.

Niagara Falls.

A list of questions regarding Hydro-Electric power was received from the Municipality of Niagara Falls on May 14th, 1910. These questions were carefully answered and a deputation from Niagara Falls later visited Toronto to consult with the Commission regarding a supply of power. Estimates were prepared and submitted, on the cost of power delivered to Niagara Falls, on June 28th, 1910, and July, 1911.

Nissouri Township (East).

A petition was received on October 26th, 1911, from the farmers of Nissouri Township, for a supply of power throughout the district. The Town Clerk was notified that this petition would be laid before the Commission's Board at their next meeting and receive their earliest attention.

North Bay.

A resolution was received from the Council of North Bay on March 21st, 1911, requesting general information relative to the granting of franchise to electric light companies and the system of striking rates. A second resolution was received on April 10th, asking the Commission to act as consulting engineer for the municipality and advise them regarding power rates and a franchise. In June, a representative of the Commission visited North Bay to secure information and make investigations of the power situation. Subsequently a resolution of Council was received requesting the Commission to prepare a full and complete report of the power requirements of the municipality. Copies of all the present existing agreements between the municipality and the power companies were secured, together with the necessary information from the books of the municipality and a full and complete report was submitted. The North Bay Light, Heat and Power Company held an exclusive lighting franchise which expired September 17th, 1911. The Nipissing Power Company controlled by the Electric Power Company has a power franchise and is supplying power to the large users, and also to the North Bay Light, Heat and Power Company. The town later negotiated with the North Bay Light, Heat and Power Company for the purpose of purchasing their distributing lines, and on September 12th requested the Commission to furnish estimates on the cost of power.

North Toronto.

An estimate was prepared at the request of the Town of North Toronto on the cost of delivering 100, 150 and 200 h.p., at 13,200 volts, from the Port Credit station, and submitted on May 23rd, 1911. The question of obtaining this power from The Toronto Hydro-Electric System was taken up, and arrangements were made that gave North Toronto a supply from this latter source.

Norwich.

A representative of the Commission visited Norwich on December 31st, 1909. The village passed a by-law to raise \$5,756.00 for a distributing system on January 3rd, 1910. A contract for 150 h.p. was submitted, Norwich, in March, for signature, and investigations were made to determine whether or not it would be advisable for them to purchase the privately-owned lighting plant already in operation. This

they eventually purchased at a price suggested by the Commission at the requests of the owner and the Council of the town. The Council passed a resolution on July 3rd, 1911, requesting the Commission to act as consulting engineer for the corporation and superintend the purchase, erection and installation of the buildings, plant and equipment necessary for the distribution of Hydro-Electric power. An estimate was prepared on the cost of the necessary buildings and equipment, and presented to the Council on August 7th. Details are given below. Plans and specifications were also prepared and tenders received for the transforming station equipment. Contracts were awarded on September 15th. Plans and specifications were later issued for the construction of the sub-station in the village, and a second by-law was passed on September 15th to raise money for a distributing system, since the by-law of 1910 had not been validated. The Commission was requested to order the necessary material for the distributing system and placed in full charge of construction. Subsequently Norwich decided to consider a small water-works plant, and one of the Commission's engineers visited the town to advise the location of their water-works pumping station as well as their sub-station. These stations will both be in operation very shortly.

NORWICH ESTIMATE.

Building	\$1,000 00	
Equipment in Station	3,725 00	
Cedar Poles	449 00	
Street Lighting Equipment	638 00	
Telephone	22 00	
Two Sets Arresters	80 00	
Service Transformers	730 00	
Weatherproof Wire	362 20	
Detail Time and Material	643 00	
		\$7,649 20
Engineering and Contingencies, 10%	764 92	
Interest during Construction	249 00	1,013 92
Webster's Plant		3,875 00
		<hr/> \$12,538 12

This does not include the possible cost of the sites.

Oakville.

A letter was received from a resident of Oakville on April 11th, 1911, requesting particulars concerning the possibility of the farmers in the neighborhood of the village obtaining a supply of power from the Commission. A reply, enclosing a copy of the Power Commission Act, 1911, was forwarded on April 12th, as well as other instructions for making formal application.

Ontario Agricultural College.

See Department of Public Works.

Orillia.

An application was received from Orillia on March 10th, 1911, for a report on a proposed development at Rugged Rapids for supplying the town of Orillia with power.

A report on the condition in that town was prepared and submitted to the Town Clerk on May 18th.

The town applied to the Commission for further information concerning rates on September 8th, 1911. The Commission advised them on September 18th that

it would be impossible to furnish the desired information regarding rates without the fullest knowledge of the cost of power to Orillia when distributed to its various users. We, however, forwarded bills used by the Toronto Hydro-Electric System showing the recommended method of adjusting the rates, and further offered to send an engineer to thoroughly investigate the situation and recommend to the Council of the town a system of charging.

Ottawa.

A request was received from the City of Ottawa for a supply of 1,500 h.p. in addition to 1,000 h.p. already called for in their contract. Contracts were drawn up between the Ottawa and Hull Manufacturing Company and the Hydro-Electric Power Commission and between the Hydro-Electric Power Commission and the City of Ottawa whereby the City of Ottawa were able to obtain this additional 1,500 h.p. A schedule of rates for the City of Ottawa was also prepared, submitted to the Commission for approval, and adopted.

Otterville.

See Report on Rural Distribution.

Owen Sound.

A letter was received on March 7th, 1910, from the Town of Owen Sound, stating that they contemplated securing power from Eugenia and Hayward Falls with the idea of obtaining a larger and cheaper supply than that which they were at present obtaining, and asking what proceeding would be necessary to have the Hydro-Electric Power Commission report on the matter. The Commission replied on March 10th, that if the Council of Owen Sound would make formal application an engineer would be sent to investigate the situation, and within a fortnight after his return submit a report to the Council.

Formal application was made, and reports on the Eugenia and Hayward Falls water power schemes were forwarded to the Chairman of the Electric Light and Power Committee of Owen Sound on April 1st, 1910.

A resolution was passed by the Council on August 17th, requesting the Commission to investigate the conditions at the municipal electric light and power plant, and also advise an equitable rate for light and power in the town. (See Report on Durham.)

Palmerston.

See Report on Durham.

Paris.

Our engineers have visited the town of Paris several times, and have prepared estimates on the cost of supplying various amounts of power to the town and the local railway system. These estimates have been submitted to the municipality for their consideration.

Penetanguishene.

Application was received from the Town of Penetanguishene for an estimate on the cost of power delivered to them from the Simcoe Railway & Power Company.

Estimates were prepared and the following prices quoted for power supplied at 2,200 volts:—

Up to 500 h.p.	\$31 00	per h.p. per year.
500—1,000 h.p.	20 00	" "
1,000—1,500 h.p.	19 00	" "
Over 1,500 h.p.	18 00	" "

The town accepted these rates and passed a by-law authorizing a contract. (See Contracts with Municipalities.)

The Commission acted as consulting engineer for the town; prepared plans and specifications; awarded the contracts for the transforming and switching equipment and sub-station building; purchased the material necessary for the distributing and street lighting system and supervised the complete installation. All construction work in connection with the municipal system is nearly completed at the present time.

Penetanguishene Asylum.

See Department of Public Works.

Petrolea.

A request was received from the Town Clerk of Petrolea on March 25th, 1911, for recommendations on a street lighting system for the village. Our engineer was sent to investigate conditions on April 12th, 1911.

The Commission prepared and submitted estimates on the first cost and annual charges for a street lighting system consisting of 100—80 c.p. 100 watt Tungsten lamps supplied with current obtained from the canning factory.

As a result of further correspondence, our engineer again visited Petrolea on July 25th to obtain a detailed plan of the town lighting and secure the approval of the Mayor, and the Chairman of the Light Commission.

Picton.

The Board of Trade of Picton requested in November, 1909, advice concerning a supply of Hydro-Electric power. The desired information was supplied, and the council passed a resolution, on November 26th, 1909, asking the Commission to submit an estimate of the cost for 500 h.p. transmitted from Trenton and the Trent River to Picton. An estimate was prepared and submitted on the cost of supplying power to Picton in conjunction with Kingston, Brockville and Prescott.

Plattsville.

An inquiry was received from the Police Village of Plattsville in October, 1911, regarding a supply of Hydro-Electric power. Resolution blanks were forwarded to the municipality together with information. Since several applications had been received from this district, an engineer visited this district on October 31st to investigate conditions in Drumbo, Plattsville, Wolverton, etc. Estimates are now being prepared on this district. (See Report on Drumbo.)

Port Arthur.

Application having been received from the City of Port Arthur for a supply of power, the Commission contracted with the Kaministiquia Power Company of Fort

William for electrical energy, and then entered into a contract with the City of Port Arthur for this power. (See Contracts and Municipalities.)

A resolution of the Utilities Committee was later received from the City Clerk requesting that an electrical expert be sent to advise the city as to possible changes or improvements in their Current River electrical development and their lighting and street railway system to secure the most economical and efficient operation.

An engineer visited Port Arthur in March. The results of his investigations were submitted in the following report:

REPORT OF INVESTIGATIONS AT PORT ARTHUR.

From information obtained from the Chairman of your Utilities Commission and as set forth in statement accompanying his letter of March 15th, we understand that you desire a report and advice on the following:—

1. *Power Department—*

(a) The economical use of the Hydro-Electric development on Current River in connection with the power supplied from the Commission's sub-station.

(b) The suggested improvements in the Current River plant and system of reservoirs.

(c) The amount of power that could be obtained from the Current River development continuously, and also the application of the power to the reduction of peak load on the Commission's sub-station which receives power from the Kaminstiquia Power Company, with recommendations for the supply of power from this station.

(d) The proper rates to charge for power delivered from the Current River power station.

(e) Report on the present condition of Current River plant and feeders.

2. *The Commission's Sub-station.*

(a) The proposed extensions and equipment for the supply of street railway service, power and light distribution and street illumination.

(b) The proposed rates for commercial power and lighting, and for street illumination.

3. *The Distribution System for Power and Lighting.*

(a) A report on the present condition of the distribution system for light and power and suggested improvements.

(b) A report on street illumination and proposed street lighting system.

4. *Electrical Distribution of Power for the Electrical Railway System.*

(a) Recommendations on the feeder system to be installed from the Commission's sub-station.

Current River Development.

The power possibilities and the storage capacity of the reservoirs up to 1908 are fully reported on in the reports of J. T. Fanning, C.E., August, 1906, Smith, Kerry & Chace, June 1st, and August 13th, 1908, and the report of the Commission on November 30th, 1908.

Mr. Fanning's report dealt with the power conditions in the year 1906, since which time improvements have been made in the storage reservoirs along the lines suggested and the extensions to plant which were contemplated have been made.

The present development has a reservoir capacity of about 1,820,000,000 cu. ft. as follows:—

Onion Lake	1,312,000,000	cu. ft.
Knob Lake	40,000,000	"
Hazelwood Lake	392,000,000	"
Ray Lake	75,100,000	"
	<hr/>	
	1,819,100,000	"

We are informed that contracts have been awarded for a new dam at the service reservoirs which will increase the storage to 24,000,000 cubic feet capacity or sufficient for 48 hours' supply for plant. This extension is necessary and will add considerably to the value of the plant for use in reduction of peak load in the Commission's sub-station.

The costs of the dams, reservoirs and permanent works of the Current River were obtained from the books of the City Treasury Department. The following is a statement of these costs and the annual fixed charges to maintain and operate plant:

Cost of Dams, Reservoirs and Permanent Works of the Current River Plant.

Service Reservoir, not including washout, but including permanent works at Power House	\$21,436 46
Onion Lake Dam	33,485 43
Extensions Onion Lake, 1908-1909	26,755 33
Hazelwood Dam	10,483 11
Knob Lake Dam	2,621 64
Ray Lake Dam	6,481 07
Paquette Dam	46,542 51
Extensions Paquette Dam and Survey, 1907-08	1,427 36
Washout of Current River Dam, etc.	32,007 69
Permanent Works on Plant up to 1907	52,763 70
Extension to Power Plant, 1907	15,526 68
Improvements, Permanent Works, 1909	15,486 35
Flume, 6 ft., 1907	12,723 95
Electrical Equipment, Power Plant, to 1909	38,503 72
Improvements in Tail Race, 1910	3,865 03
Electrical Equipment, 1910	1,987 87
Local Power Line	2,034 10
Engineering and Miscellaneous Accounts	1,442 52
Real Estate	6,230 86
Reports of Smith, Kerry and Chace	1,125 11
	<hr/>
Total Cost, Current River Development, to December, 1910	\$333,030 49
Contemplated additions for Dams, 1911	20,000 00
	<hr/>
	\$353,030 49

The annual fixed charges on above plant will be approximately as follows:—

Annual Interest, Sinking Fund and Instalments on \$336,000 of Debenture	\$24,486 53
Annual Fixed Charges to maintain and operate Plant	6,500 00
Salaries and Operating Expenses	5,520 00
Share of Office Administration	500 00
	<hr/>
Total Cost to operate Current River Plant	\$37,006 53

The present capacity of the plant is capable of developing with the storage available in the reservoir, a peak load of 1,600 h.p. for four or five hours each day,

and for the remainder of the day a continuous load of 500 to 700 h.p., these estimates being based on the efficient storage and regulation of run off. With careful attention to the regulating of the flow from the reservoirs and using the plant for reduction of peak load on the Commission's station, this plant can be made to pay when the above capacity of plant is in excess of the amount of power required to be taken from the Commission.

The proper attention to restricted hour power on this station may give a diversity load factor which will bring a sufficient revenue to pay costs on a smaller maximum load than the maximum capacity of plant.

Capacity of Power Plant.

The following Hydro-Electric equipment is installed in the Current River Power Station:—

- 1—660kw., 2,200 volt, 60 cycle, 450 r.p.m., Allis-Chalmers-Bullock generator installed in 1909 and direct connected to:—
- 2—30-in. Crocker turbines built by Jenkes Machine Co.
- 2—250 kw. 2,200 volt, 60 cycle, 450 r.p.m. generators manufactured by Bullock Electric Co., direct connected to:—
- 1—25-in. Crocker turbine built by Jenkes Machine Co.
- 1—200 kw. 550 volt, 500 r.p.m., d.c. generator direct connected to a Crocker turbine built by Jenkes Machine Co.
- 1—6 kw. 125 volt, 750 r.p.m. exciter.

The rated capacity of the alternating current generating equipment is 1,500 h.p. and for the direct current equipment 270 h.p. The plant is capable of carrying a maximum load of 1,600 h.p. of alternating current power at 2,200 volt, 60 cycle and the railway generator 300 h.p. at rated voltage.

The switchboard equipment for controlling the above plant consists of four panels containing the following instruments and control apparatus:—

Panel No. 1.

- 3—Ammeters,
Combination field and exciter rheostat handles.
- 1—Field Switch,
- 1—Condit 200 amp. automatic oil switch,
- 1—Bristol Recording meter on swing bracket,
- 3—Voltmeters.

Panel No. 2.

- 3—Ammeters,
- 1—Ammeter for the Exciter,
Volt Meter Plugs,
- 1—Curve Drawing voltmeter,
- 1—Field Switch,
- 1—Hartman Switch.

Panel No. 3. For 250 kw. Generator.

- 3—Ammeters,
- 1—Voltmeter,
- 1—Ground Detector,
- 1—Field Switch,
- 1—Exciter Switch,
- 1—Oil Switch, Condit,
- 3—Sets of Fuses.

Panel No. 4. For D. C. Railway Generator.

- 1—Ammeter, 600 amp.
- 1—Voltmeter,
- 1—Circuit Breaker,
- 1—3-Pole Switch,
- 1—Field Switch.

The Hartman and Condit switches on Panels No. 2 and No. 3 should be replaced by 2,200 volt, 200 amp. automatic oil switches, and a synchronizer should be installed on the switching panel.

The switchboard will have to be rewired and arrangements made for synchronizing the three a.c. machines. The accompanying wiring diagrams and specifications for switchboard will give sufficient information to have this carried out.

For the four outgoing feeders, oil switches and panels should be provided, with automatic oil switches, synchronizing and voltmeter receptacle and potential transformers for use in checking voltage and for synchronizing Current River machines with Commission's station busbars. Each outgoing feeder should be provided with lightning arresters, but these are not called for in the specifications for the switchboard in the Current River station, which is hereto attached.

Answering Your Questions in Order.

1.—(a) We would recommend that the Current River development be used in conjunction with the Commission's sub-station to reduce the peak load on this station, and in addition to carry the load of the power consumers within one-half mile of the Current River station, and up to the capacity recommended for continuous power. The generators in the Current River station should be arranged to be run in parallel, proper synchronizing devices being purchased for this purpose.

(b) The improvements necessary on Current River station are as follows:—

The present switchboard will have to be rebuilt and some of the equipment discarded or used for other purposes. New apparatus should be purchased suitable for the rearrangements as suggested and for the purpose of synchronizing of machines. The apparatus required and the arrangement suggested would be that called for in the Specification for Switchboard for City of Port Arthur Current River Station. In addition, we would recommend placing lightning arresters on all outgoing feeders.

The railway generator should be placed on its original foundation and connected to the waterwheel provided for it.

The load on this plant must be so adjusted that for the winter months there will be sufficient water to operate the railway generator or other power load in vicinity, and also take care of a peak load of about 1,600 h.p. It will require careful attention and economical use of the storage reservoirs.

(c) With proper regulation of run-off, you could obtain from the Current River system 500 to 700 h.p. continuously and be able in addition to take care of a peak load on system of 1,600 h.p. for 4 or 5 hours each day. We would recommend that this plant be utilized in the above way.

(d) The power delivered from the Current River Station for reduction of peak load on Commission's Station should be charged for at the same rate as you are paying Commission for power; and for power delivered to consumers the rates charged for power from Commission's Station should be used. The rate for power or light to consumers should be uniform for classes whether taken from Commission or Current River Station.

(e) We are unable to report on the condition of the reservoir dams, as these were not examined.

The apparatus in the Current River Station is in first class condition, with the exception of the switchboard, which will have to be rebuilt, as recommended.

The feeders are in fair condition and only require proper maintenance, and should be remodelled when new switchboard is installed.

2.—(a) It is proposed that three railway feeder panels be installed for the supply of power to the street railway. These will be in addition to the motor generator panels and feeder panels already on order.

The extensions to this station which we have already recommended are sufficient for your present needs.

Our recommendations on railway feeder equipment with prices obtained are hereto attached.

Our recommendations on street illumination are given below.

(b) We would recommend the use of the following rates for residential and commercial lighting, and power:—

A large number of your lighting customers are at present supplied on the flat rate with a twelve hour service. This system of flat rate charging for power or light is responsible for a large waste of energy, which is readily shown by the connection of this part of the system at any time, the load on the circuit even during the day being from 500 to 600 h.p.. Your customers do not cut off their lights when they are not required, with the resultant wasted energy, which considerably adds to your peak load. We would strongly recommend the giving of a 24 hour service to all and the installation of meters to all customers having five lamps or over, connected.

The installation of meters will decrease your lighting peak considerably, and also permit of the use of the restricted hour service for power. The objection raised that your city would not be nearly so brilliant when meters are installed will be greatly overbalanced by the much better street lighting system that you will install in the near future. Your streets will be so well lighted that it will not be necessary to rely on the illumination that comes from your houses to make your city look brilliant, and further, the small amount of light from the houses costs the city a large sum of money when they are supplied on the flat rate. We would therefore recommend that the following rates be adopted:—

Residential Service.

A monthly service charge of four cents (4c.) per 100 square feet of floor area, plus an energy charge of three and one-half cents (3½c.) per kilowatt hour, subject to a discount of 10 per cent. for prompt payment.

The accompanying application for lighting service and lighting contract will

give particulars as to the method of charging and the conditions of contract. The Commission will very shortly revise the above contract in a form more convenient for reference. For the present the above form will be suitable for the making of contracts.

The commercial lighting rate for stores, factories, hotels, etc., is given on the above lighting contract. We do not recommend the renewal of burnt out lamps, but would advise the city offering to furnish high class lamps at cost.

Commercial Power Rates.

3 phase, 60 cycles, 110, 220, 550 or 2200 volts.

Flat Rate.—At flat rate charge of thirty-six dollars (\$36.00) per year per horse-power of maximum demand for the first ten horse-power, all excess at twenty-seven dollars (\$27.00) per year per horse-power of maximum demand. Ten per cent. (10%) discount is allowed for prompt payment.

Differential Rate.—A service charge of \$1.35 per month per horse-power for the first ten horse-power of maximum demand, all excess at \$1.00 per horse-power of maximum demand, plus an energy charge of $2\frac{1}{2}$ c. per kilowatt hour for the first fifty hours monthly use of the maximum demand, $1\frac{1}{2}$ c. for the next succeeding fifty hours use and $\frac{3}{4}$ c. per kilowatt hour for all excess. Ten per cent. (10%) discount is allowed for prompt payment.

The customer may have the option of taking restricted hour power at the discount shown on the accompanying printed copy of Power Contract. This power contract also includes conditions of contract. The maximum demand may be estimated in case of large users, or for small motors it may be taken as the installed capacity of motors or apparatus.

Elevator power may be placed under the differential rate.

We are at present considering the form of contracts and general conditions, and as soon as the Commission approves of the same we will be pleased to forward you a copy. In the meantime, the conditions given on accompanying contracts will be satisfactory. The rates for street illumination are given below in report on street lighting.

3.—(a) We have thoroughly examined your distribution system of power and light and find that it is only in a fair condition, and that with the present location of the distributing system the main circuits of the system will have to be rearranged and the entire system practically rebuilt to place it in good working condition. In many cases the poles have been improperly set, and have exceeded their useful life, and should be replaced. Nearly all poles will require attention. The overhead line work is at present in poor shape and should be remodelled at the same time your new street lighting system is installed, with the exception of the new construction which has been recently built. We would advise the rebuilding of the overhead system, carrying the work on systematically. For this purpose as large a gang should be placed as can be economically handled without seriously interfering with the service.

The first step in the reconstruction of your plant would be to determine as closely as possible the load curve, taking into account the probable increase in load. The transformers should be placed as near the centre of load as the arrangement of circuits will permit. We have taken a number of voltage measurements during loading periods to determine the voltage distribution of circuits and the loading conditions. We found that transformers were over-loaded, phases unbalanced,

and the load on transformers not balanced, resulting in unequal voltage distribution which, in some cases, was as great as 20 per cent. Also in many cases your lines were overloaded.

To properly carry out the reconstruction of the system, it will be necessary to obtain a systematic record of the load on all your transformers, its distribution as to phase, the condition of load on each low tension winding and the voltage regulations of these circuits.

Upon obtaining and properly recording these data, they should be studied and the circuits designed to give balanced loads and voltages on phases and secondary circuits, with a voltage regulation of circuit of three per cent (3%) or less. The main feeder regulation will have to be adjusted for the centre of the voltage on these circuits, and to obtain good regulation of the voltage on these circuits we would recommend the installation of feeder regulators. The system of feeders that we are suggesting for the re-arrangement of circuits has been designed with the understanding that at some future date regulators will be installed. The use of regulators with a voltage range of $7\frac{1}{2}\%$ below and above normal will give a better voltage regulation on your system and at a less cost than an increase in the copper sections of feeders to obtain the same range of voltage regulation.

To re-arrange the distribution system for Port Arthur to adapt it to being supplied from both the Current River Power Station and the Hydro Sub-station on Van Norman Street, the following assumptions have been made.

It is assumed that on all lines the power factor will not go below 85%; that in addition to the transformer capacities shown on the blue prints supplied us by the Town of Port Arthur there will be a load of approximately 1500 h. p. in the vicinity of the C. N. R. Elevator. It is also assumed that the Current River Station will have a maximum load of not more than 1600 h. p.

The changes suggested in the layout are as follows:—

2,200 Volt Feeders.

That a tie line be run from the sub-station on Van Norman Street to the Current River Station, consisting of two circuits of No. 0000 B. & S. copper cable to be erected on the following streets:—

Leaving the sub-station on Van Norman Street, the line will run north on Shepherd Street to Dawson, then east on Dawson to College, then north on College to River, then east on River to Court, then north on Court and across the Current River on the present unoccupied poles, and from there east to the Current River Sub-station. In following this course it will be necessary to erect poles on River Street from Peter to Algoma. This line will also take care of any load that should be along this course.

A tie line and feeder circuit for mixed lighting and power service between the sub-station and the Current River Station consisting of one circuit of No. 0000 B. & S. copper cable should be run as follows:—

Leaving the sub-station on Van Norman Street, it should run east on Van Norman to Algoma Street, then north on Algoma to Cameron then east on Cameron to Cumberland, then north on Cumberland Street to the Current River Station.

It is found that with the three feeder circuits of No. 0000 B. & S. cable between the sub-station and the Current River Station the Current River Station can be supplied with a total of 1,500 h.p., with a voltage drop of 15.1% and a power loss of 8.35%.

A feeder regulator should be put in the power and feeder circuit just outlined

above, having a capacity of 200 amperes and a voltage regulation of $7\frac{1}{2}\%$. In this way it will be possible to better the poor voltage regulation that this line would have in case it should be required to carry the full amount of power.

A power feeder circuit should be run from the sub-station on Van Norman Street south on Hill Street to St. Patrick Square, then east on St. Patrick Square and Pearl Street to Cumberland St. At the corner of Pearl and Cumberland Streets it would feed the power load east of and along Cumberland Street as far south as Bay Street and as far north as Van Norman Street; should the Canadian Northern Elevator take power, it should also take care of this. From the sub-station to the corner of Pearl and Cumberland Streets the line should consist of two circuits of No. 0000 B. & S. cable. North on Cumberland Street from Pearl Street one Circuit of No. 0 cable should be run as far as Van Norman and south on Cumberland from Pearl there should be run one circuit of No. 0000 B. & S. cable and one circuit of No. 0 cable as far as Bay Street. In case of the C. N. R. Elevator taking power, the No. 0000 B. & S. cable should be extended to it. With the elevator taking 750 h.p. and other power users along the line taking the balance of the feeder capacity, making a total of 1,300 h.p., this line will give a total voltage drop at the corner of Pearl and Cumberland Streets of 6 per cent. and at the C. N. R. Elevator of 10 per cent.

A lighting feeder should be run over the same course as the previous power feeder as far as the corner of Pearl and Cumberland Streets. This should consist of one circuit of No. 0000 B. & S. copper cable and have inserted in it at the Van Norman Street Sub-station a voltage regulator of 200 ampere capacity, capable of a total voltage variation of $7\frac{1}{2}\%$ per cent. Assuming a 600 h.p. load on this line, it is found that the voltage variation at the end of the line will be about 5 per cent., hence the desirability of inserting the regulator.

A power feeder should be run from the Van Norman Street Sub-station south on Hill Street to the corner of Fort William Road and Second Street. This should consist of two circuits of No. 0000 B. & S. cable.

Assuming the National Elevator taking 800 h.p. and other power users along this line taking enough additional power to make up the full feeder capacity of 1,300 h.p., it is found that the voltage drop at the National Elevator will be about 10 per cent. Should the National Elevator take power this double circuit of No. 0000 B. & S. cable should be extended to it.

A lighting feeder circuit should be run over the same course as the foregoing power feeder as far as the corner of Algoma and Queen Streets. This should consist of one circuit of No. 0000 B. & S. copper cable. A feeder regulator should also be inserted in this circuit in the Van Norman Street Sub-station, having a capacity of 200 amperes and capable of a voltage variation of $7\frac{1}{2}\%$ per cent. The present lighting feeder running west on Red River Road may be tapped on to either of the foregoing lighting feeder circuits.

Tie Line and Feeder—Sub-station to Current River Station.

	lb.
144,000 ft. No. 0000 B. & S. D.B.W.P. Cable.....	107,180
Power Feeder—Substation to Pearl and Cumberland and along Cumberland, 37,200 ft. No. 0000 B. & S. D.B.W.P. Cable	27,714
9,600 ft. No. 0 D.B.W.P. Cable.....	3,725
Power Feeder—Substation on Fort William Road and Second St., 66,800 ft. No. 0000 B. & S. D.B.W.P. Cable	49,766

Lighting Feeder—Substation to Pearl and Cumberland Streets, 15,000 ft. No. 0000 B. & S. D.B.W.P. Cable...	11,175
Lighting Feeder—Substation to Bay and Algoma Streets, 18,800 ft. No. 0000 B. & S. D.B.W.P. Cable.....	14,006
291,400 ft.	213,566 at 16c. = \$34,170 56
Freight and Cartage at \$1.00 per C.	2,135 66
Erection at \$5 per M. ft.	1,457 00
Poles, Arms, and Insulators erected	1,620 00
Three Regulators installed	9,000 00
Total	\$48,383 22

(b) The present system of street lighting by multiple arcs and low power incandescent lamps is insufficient for the purpose, and could be considerably improved upon. We would recommend that the entire equipment now in service be discarded and a new system of multiple and series tungsten lamps be installed, with standard pole, bracket, with reflectors for side streets and an ornamental bracket with globe for the main streets. We are pleased to offer a few suggestions along these lines. Pole brackets, as shewn in the accompanying sketches, for your down-town streets would prove ornamental and could be placed on both sides of the street. Two brackets to a pole, the pole being used in addition for carrying the supporting span wires of the trolley, and provided underground construction was not used at present we would recommend placing low tension lighting and service wires as shown on short brackets. These poles can be ornamental or plain cast-iron, depending on the amount of money available, or provided a more ornamental pole is desired, we would suggest a type similar to the enclosed cut.

Concrete poles can be used to advantage on residential streets, and they give a good appearance with the ornamental brackets with 10 in. globes. The concrete pole for combined use of carrying trolley wires and as a lamp standard has not met with entire success, although it is possible to design a pole that would withstand these stresses satisfactorily.

We would recommend the placing of all wires underground on the main streets, Cumberland, Arthur and Court Streets, and any others that you might desire. To obtain a good lighting effect it will be necessary to place lamps on every pole in residential districts, excepting the thinly populated, outlying sections. The ornamental bracket and globe with lamp should be placed about 9 ft. from ground. The bracket with reflector should be placed from 12 to 14 ft. above roadway or sidewalk. We would recommend a reflector similar to the Philadelphia type, using 100 watt lamps.

The following is an estimate of the work of installing a multiple system of lighting, in the area bounded by Wilson, Dufferin, Banning, Arthur, Jean, Dawson, Victoria and Water Streets; the remainder of the town being served by series lighting, lamps being placed 130 ft. apart, supplied from 6.6 amp. 150 light, constant current transformers located in basement of Municipal Buildings or near by.

ESTIMATE:

254,000 ft. No. 6 B. & S. D.B.W.P. Wire—25,400 lb. at 15¼c.....	\$3,873 50
Freight, at \$1.00 per C.	254 00
Erection	762 00
Line Construction	354 00
550 Lamp Brackets and Lamps, Multiple System	2,200 00
8.5 k.w. 2,200-220-110 volt Transformers	600 00
850 Series Brackets and 6-16 k.w. Constant Current Transformers	13,000 00
Total	\$20,243 50

No allowance has been made for engineering or interest during construction. We have included in this estimate two-light clusters every 100 ft. on one side of Water Street from Pearl Street to C. P. R. Station, two-light clusters every 100 ft. on both sides of Arthur, North, Water and Waverley. Arthur Street and Waverley around fork (one side) on Cumberland, Bay to Cameron (both sides), on Court Street, Pearl to Van Norman (both sides).

The bracket shown on accompanying sketches can be placed on wooden poles by flattening side. The poles should be neatly painted with grey paint, a dark shade, for 6 ft. from ground. The remainder light grey.

We would recommend that the work on street lighting be commenced at as early a date as possible, and that when installing this system your lines could be reconstructed at the same time.

The overhead telephone lines may be placed below the power circuits in reconstructing your overhead system, leaving sufficient space between for the placing of transformers.

March, 1911.

Port Credit.

A request was received from Port Credit in December, 1909, for an estimate on the cost of distributing a supply of power. An estimate was prepared and submitted. One of our engineers visited this municipality several times during 1910, but since it is a Police Village and had no authority to contract, nothing could be done at that time. Following the passage of the Rural Distribution Bill of 1911, by the Legislature, a copy of which was sent to the Inspecting Trustee of Port Credit, the committee of the village passed a resolution requesting an estimate on the cost of power delivered to the village. Several meetings were arranged between our engineer and the Village Board for the purpose of obtaining the necessary information, after which a second estimate on the cost of power was prepared and submitted.

Port Credit Brick Company.

A contract was made with the Port Credit Brick Company at Port Credit for a supply of power and a line built to operate at 13,200 volts from the Commission's Port Credit Station to the premises of the Brick Company. The Consulting Engineer of the Brick Company secured the approval of the Commission before the installation of any of their electrical equipment, in accordance with a clause to that effect in the contract. Power was delivered to them in June, 1911.

Port Stanley.

The Council of Port Stanley requested an estimate on the probable cost of Hydro-Electric power supplied to the Municipality, in November, 1909. An estimate was prepared on the cost of transmitting 200 h.p. from St. Thomas station to Port Stanley, on November 22nd. No further action was taken by the village until the early part of 1911, when another request for information was received, this time from the Solicitor of the village. In response to the latter inquiry, a resolution was prepared and sent together with a request that it be submitted to the Council for approval. An engineer was sent to Port Stanley on March 2nd to investigate conditions, and at that time an application was made for an estimate on the cost of constructing a single circuit pole

line from the southern limits of St. Thomas to Port Stanley. Several succeeding visits were made to Port Stanley by our representative to ascertain conditions, and to obtain data for a valuation of the privately-owned lighting plant. An estimate on the value was made and submitted, at the request of Port Stanley, to their solicitor in May, 1911. Estimates were also prepared on the cost of distributing Hydro-Electric power in Port Stanley, the Commission providing the step-down equipment.

The estimates for the material necessary to adapt the present plant to Hydro-Electric power were submitted to Port Stanley on June 21st, 1911. The Council requested the Commission on June 27th to act as Consulting Engineer for the village as well as agents in the purchase of material. Specifications were prepared for the building equipment and tenders were called for by the Commission on July 18th, 1911. The Corporation of Port Stanley submitted a by-law for the purpose of raising \$6,875.00 for the purchase of the present plant, and \$5,875.00 to adapt it to Hydro-Electric power on August 9th, 1911. The by-law was carried by a majority of 172. A resolution was passed on August 16th by the village Council authorizing the Commission to take charge of the installation of a distributing system in the village and the purchase of all material. The Commission immediately ordered the necessary material and sent a man to Port Stanley to superintend the erection of the system.

Several estimates were prepared on the cost of transmitting various amounts of power to Port Stanley, and a contract for 50 h.p. at \$79.89 per h.p. per year was finally submitted to the village on September 29th. Specifications and plans for their station building were also prepared at the request of the municipality. The contract for power was signed on October 6th, 1911.

Preston.

During 1909 the Commission acted as Consulting Engineer to the town of Preston; issued specifications and called for tenders on the electrical equipment, as well as the necessary material for their distributing system. Tenders were received during November and December, 1909, and early in 1910 contracts were signed, in accordance with a resolution of the Preston Council dated December 21st. A by-law to provide the necessary funds for a distributing system was submitted and carried by a large majority on January 31st, 1910. In February the Municipal Council authorized the Preston Light and Water Commission to handle all questions and action pertaining to the delivery of Hydro-Electric power in the municipality. A resident engineer was appointed for the district, including Preston, Galt and Hespeler, who supervised the erection of material and aided the municipality in its power canvass. The purchasing of material and the general supervision of deliveries and shipments from the different contractors were handled by the Toronto office. A resolution was passed on June 1st, 1910, by the Light and Water Commission of Preston authorizing the Hydro-Electric Commission to call for tenders on two 250 gallon motor-driven turbine pumps. Later a request was received from the Town Council asking that they be allowed to supply power outside of the Corporate Limits to individual residents in the Township of Waterloo. They were advised to obtain the permission of the Township Council of Waterloo before proceeding to supply power outside the limits of their own township. The Township of Waterloo granted their request. Preston was notified on October 25th that the Commission was prepared to furnish twenty-four hour power, but it was not until November 29th, 1910, that the municipality obtained

a supply of power. Power was first delivered to the Preston station for test purposes on November 14th. Considerable attention had been given to power rates and forms of bills during 1911. Our representatives have spent considerable time supervising the installation of material and adjusting difficulties arising from time to time between the power-users and the Corporation of Preston. Since power was first supplied the load at Preston has been rapidly increasing until at the present time this municipality is taking a peak load of over 300 h.p.

Rockwood.

At the time our engineer was sent to investigate the power requirements of the towns of Acton and Georgetown, he was also instructed to visit Rockwood and collect data on the power requirements of that village and vicinity. It was estimated that about 50 h.p. would be required here, and estimates were accordingly prepared for this quantity in conjunction with those for Acton and Georgetown. (See Report on Acton.)

Rural Distribution.

Numerous inquiries were received from residents of police villages and various rural districts regarding Hydro-Electric power previous to the passage of "The Power Commission Act" of 1911, which now permits a police village or group of residents to make application to the Hydro-Electric Power Commission for a supply of power through the Council of their township.

Since the passing of this Bill many police villages and rural districts that had been endeavoring to interest the townships in the matter, now applied to the Commission for estimates on the cost of power. The following have applied for estimates in accordance with the Power Act:—

Baden, Beachville, Beverley Township, Caistor Centre, Courtland, Drumbo, Dublin, Guelph Township, Middleton Township, Mimico, Nelson Township, New Toronto, E. Nissouri Township, Port Credit, Plattsville, Rockwood, Schaw, Scarborough, St. Thomas vicinity, Smithville, S. Norwich Township, Springford, Otterville, Thorndale, Waterdown and York Township.

The conditions which have presented themselves since this line of work was started offer a number of engineering problems which require thorough study. Our engineers have investigated conditions in the villages and districts just mentioned, and also in those villages where inquiries were made as to the proper procedure to pursue in making application for power. Information and instruction as to what data their petitions should contain, have been given, and a study of the conditions has been made in each particular case in order to secure some idea of the probable power demand. This necessarily involved a great amount of work, since it was essential that the engineer, when making the investigation, visit nearly every prospective power-user and individually examine the existing conditions. In addition, plans had been made for a cheap, yet serviceable system of transmission and transformation for use in these rural districts, and with the information obtained, an investigation is now being made with the idea of ultimately developing a system for the distribution of power through rural districts that will be both substantial and economical in construction.

The local distribution in the police villages is not so intricate a question as the supply for the rural districts, and we have been able to submit estimates on the cost of delivery with a minimum amount of delay. Consequently a number of the police villages have been able to submit the requisite money by-laws and enter into contract with the Commission for a supply of power, and in many the distributing systems are under construction. (See Reports.)

Sandwich.

While investigating the possible methods of supplying power to Windsor, the requirements of the Town of Sandwich were also investigated and considerable data secured. (See Report on Windsor.)

Sarnia.

A copy of resolution dated November 29th, 1910, was received from the Town of Sarnia, requesting an estimate on the cost of transmitting and supplying 3,000, 5,000, 7,000 and 10,000 h.p. to that municipality. The following estimates were submitted on December 27th, 1910, for 13,200 volt power assuming a load of 1,000 h.p. at or near Strathroy:—

Municipality.	H.P.	Cost per h.p. per annum.
Sarnia	3,000	39.21
Strathroy Station.....	1,000	39.61
Sarnia	5,000	31.94
Strathroy Station.....	1,000	36.90
Sarnia	7,000	28.45
Strathroy Station.....	1,000	35.18
Sarnia	10,000	24.89
Strathroy Station.....	1,000	33.69

Additional estimates on the cost of supplying power to Sarnia were also made in connection with a supply of power to Windsor. (See Report on Windsor.)

Scarboro' Township.

A communication was received from the Clerk of the Township of Scarboro', on September 4th, 1911, respecting a supply of power for Birch Cliff and the neighborhood, in accordance with the Power Commission Act of 1911. A petition has been received, and investigations are at present being made. (See Report on Rural Distribution.)

Schaw.

Verbal requests having been received from various operators of stone quarries at Schaw, relative to a supply of Hydro-Electric power, an engineer was sent there on August 3rd, 1911, to investigate conditions.

It was found that there was a demand for approximately 250 h.p. Estimates were accordingly prepared and submitted for 2,200 volt power at an estimated cost of \$34.48 per h.p. per year.

Seaforth.

A communication received from the Mayor of Seaforth, dated January 7th, 1910, requested particulars regarding a supply of Hydro-Electric power for the town. An engineer was sent to investigate conditions there as well as in other towns west of Stratford, including Dublin, Mitchell and Sebringville. It was found that there was a demand of about 400 h.p. in Seaforth.

Estimates were accordingly prepared and submitted on the cost of transmitting and supplying Seaforth at a cost of \$41.25 per h.p. per year for 400 h.p.

Estimates were also made on the cost of the transforming station and switching and distributing equipment. Two by-laws were passed by the town in August, 1910, one authorizing the Town Council to enter into a contract with the Hydro-Electric Power Commission for the supply of power, and the other authorizing the Council to issue debentures for \$25,000 to cover the cost of apparatus necessary to receive and distribute power. A contract was signed for 400 h.p. at \$41.25 per h.p. per year.

The Engineering Department of the Commission was later appointed consulting engineer for the town.

Specifications were prepared covering the sub-station building and equipment, consisting of 3-150 kv-a. single phase 13,200/2,300 volt transformers, 13,200 volt switching and protective equipment, 2,300 volt switching and feeder equipment and constant current transformers with control apparatus for street lighting.

Tenders were called for and received covering all of this equipment, and forwarded to the Corporation with our recommendations for their approval, after which the following awards were made:—

Three 150-kv-a. single phase transformers to the Canadian Crocker-Wheeler Company, St. Catharines, the balance of the electrical equipment to the Canadian General Electric Company, Toronto. We were also able to arrange between the Canadian General Electric Company, Seaforth, and the Town of St. Mary's for the installation in Seaforth of certain apparatus that had been purchased by the Town of St. Mary's but which had afterwards been found unnecessary, due to changes in station arrangement.

The contract for the sub-station structure was locally awarded. The building was constructed strictly in accordance with plans and specifications prepared by the Engineering Department.

All apparatus previous to being shipped from the factory was inspected and tested by our engineers, who made complete reports of these inspections. The installation of all equipment was made under the direct supervision of the Engineering Department. Our representative spent two days a week in the town going over the various details of construction; giving the necessary suggestions and instructions for the proper installation of the sub-station equipment and the street lighting distribution system.

The construction here is now fast approaching completion, but after the system has been placed in operation our engineers will continue to visit the town at least one day a week for the purpose of advising the local superintendent and increasing the power load.

Shakespeare.

An engineer was sent to investigate the power requirement of Shakespeare, and found that there was a demand for about 35 h.p. (See Report on Tavistock.)

Shallow Lake.

See Report on Durham District.

Smithville.

An inquiry was received from the Clerk of the Township of South Grimsby, on January 12th, 1911, relative to the possibility of obtaining 100 h.p. for the village of Smithville.

Investigations were made with the idea of supplying the village, together with other municipalities in the district, from a transformer station located near St. Ann's. (See Report on St. Ann's.) A number of the municipalities in the district have been visited and investigations are at present being made to ascertain the possibility of supplying them with power under the Power Commission Act of 1911. (See Report on Rural Distribution.)

Sparta.

An inquiry was received from Sparta, dated February 13th, 1911, requesting information as to the possibility of supplying power to farmers in the neighborhood.

Springfield.

An inquiry was received on February 13th, 1911, from the Reeve of the Village of Springfield, who desired to ascertain the possibility of the village securing a supply of Hydro-Electric power.

Springford.

At the time our engineer was investigating conditions in the neighborhood of Otterville and South Norwich Township, he visited Springford, and secured information relating to the requirements of the vicinity, and also gave instructions as to the proper procedure to follow should the residents desire to secure power from the Commission. (See Report on Rural Distribution.)

St. Ann's.

Numerous requests were received from different Municipalities located between Hamilton and St. Catharines for estimates on the cost of power. To ascertain the probable demand in this district, our engineer made a complete power survey during June, 1911, the results of which are outlined in the following report:—

REPORT ON GRIMSBY DISTRICT WITH STATION AT ST. ANN'S.

Grimsby.

Water Works Plant, at beach on the west side of the creek, is using one 40 h.p. motor direct connected to a triplex pump and one 20 h.p. motor similarly connected. This plant is using 40 h.p., pumping 225,000 gallons daily at a pressure of from 130 to 140 lb. This plant should be enlarged and other pumps installed which will require about 60 h.p. 24 hour power to operate.

Grimsby Beach Co. (2¼ miles east of the village).—This Company is at the present time being supplied on a 75 h.p. contract. In all probability, with the increased lighting load they wish to take on, this demand will reach 100 h.p., being required only during the summer months.

Theal Bros. (Flour and Feed).—This Company operates a 20 h.p. motor driving a chopping mill. Load factor on this motor is about 25 per cent.

Specialty Mfg. Co.—This Company is at present using about 20 h.p. of steam power and anticipate requiring 40 h.p. in 1912 or 1913.

Robinson and Werner (Planing Mill).—Are using about 40 h.p. steam power, refuse being used for fuel. They claim that they could use electric power to advantage and sell their refuse readily.

Bell Farms, Limited.—This Company has a 95 h.p. Leonard engine and 550 lights installed, and are just completing a canning factory at the village limits of Grimsby. They estimate they could probably use 30 h.p. electric power.

Dominion Canneries, Limited.—This Company requires steam in cooking and in other operations, but could use some power for special work and lighting.

D. Marsh (Planing Mill).—Mr. Marsh has a new 35 h.p. engine operating from an old 25 h.p. boiler, the latter being too small for his plant. He claims that he will require more power next year to the extent of 20 h.p.

Street Lighting.—This is accomplished at the present time by 35 24 c.p. carbon filament lamps with no reflectors. They should have at least 50 80 watt Tungsten lights.

Rural.—Between Grimsby and Stoney Creek there are about 155 houses, between Grimsby and Beamsville about 65, some of which are already wired and using electricity for lighting purposes.

Beamsville.

Beamsville Pressed Brick and Terra Cotta Co.—This plant is located about $2\frac{1}{4}$ miles west of Beamsville and uses as much as 100 h.p. at different times, the average load being about 45 h.p. It is probable that 60 h.p. could be used here.

James Hewitt (Mill).—This mill would require 20 h.p. in addition to lighting.

Beamsville Preserving Co.—This Company requires steam for operation and cooking, but could use electricity to operate from 50 to 75 lights.

R. H. Davey (Printer).—Requires about 5 h.p., which would operate at a load factor of about 15 per cent.

Mr. Wilson (Baker).—Is at present using a 5 h.p. gasoline engine.

Lighting.—Street lighting in Beamsville is accomplished by the use of forty 32 c.p. carbon lamps. Power is supplied for lighting service at nights only for house lighting purposes.

Stoney Creek.

It is estimated that the total demand for power and lighting here would be about 30 h.p.

Fruitland.

Fifty h.p. would meet the needs of this village for power and lighting purposes, the total load being rural, with the exception of the brickyard.

Winona.

Power would be required here for lighting purposes only, it being estimated that 65 h.p. would meet the needs of the village.

Silverdale.

There is one saw mill here and two seed cleaners. It is estimated that 10 h.p. would take care of the total power and lighting requirements.

Smithville.

The power consumers here are as follows:—

A. Lymburner (Cheese Manufacturer).—Employs an 8 h.p. gasoline engine.

Jacob Morley.—Employs a 50 h.p. producer-gas engine to operate his mill, but would like about 75 h.p. electric power.

Wm. Sheppard (Foundry).—Uses a gas engine, gas being supplied from his own well. The flow of this gas is very uncertain. He could use 8 h.p.

Zimmerman Mfg. Co. (Planing Mill).—Employs a gasoline engine, but would like 25 h.p. of electric power.

Murray and Company (Seed Mill).—This mill would require about 6 h.p.

T. H. and B.—The railway is at present using a 15 h.p. gasoline engine for pumping purposes. It is very unsatisfactory and the company would replace it with electric power.

Lighting.—About 21 h.p. would meet the house and street lighting requirements of the village. It is estimated that the total demand of the village will be about 150 h.p.

Dunnville.

Power users in Dunnville are as follows:—

Canadian and American Gasoline Engine Co.—Employ a gas engine and natural gas of about 50 h.p. capacity. They are doubtful of their gas supply, and would replace their plant by electric drive requiring about the same quantity of power.

Dominion Hammock Mfg. Co.—This Company also uses a gas engine, with natural gas, 25 h.p. capacity.

Dunville Carding Mills.—This Company uses about 75 h.p. water power from the canal. They secure their power at a very low rate.

Erie Knitting Co.—This Company uses a 15 h.p. gas engine delivering from 6 to 8 h.p.

W. A. Fry (Publisher).—Employs a 3 h.p. gasoline engine.

Stephen Haney and Son (Mill).—This mill also uses water power from the canal.

Jas. Phillips (Creamery).—Use a 5 h.p. gas engine.

Wm. Shirton Co.—This Company at present uses 125 h.p. gas engine and a 30 h.p. steam engine. They state that they require additional power in the mill and would consider contracting for electric power up to 20 h.p.

Standard Foundry and Machinery Co.—Have a 25 h.p. gas engine installed.

J. F. Vanderburg (Laundry).—Employ a 5 h.p. gas engine.

O. E. Wilson (Grist Mill).—This mill uses water power supplied from the canal.

W. T. Wiemer and Son.—Claim they could use 5 h.p. to advantage.

Monarch Knitting Co.—This Company is at present generating its own electric power, having two 50 k.w., 125 volt, d.c. generators driven by a gas engine, developing a maximum load of 150 h.p. They could use 20 h.p. additional power to advantage.

Waterworks.—They are at the present time operating two 80 h.p. boilers with gas for fuel, which drive two pumps, one having a capacity of 750,000 gallons per day and the other 1,000,000 gallons per day operating under a normal pressure of 40 lb. and 110 lb. in case of fires. The daily use of water is between 350,000 and 375,000 gallons.

Dunnville Electric Light Co.—This Company at the present time supplies the town with power for street lighting and house lighting purposes, their generating equipment being driven by water obtained from the canal, the maximum load being between 60 and 80 h.p. It is estimated that the requirements of Dunnville could be met with a total supply of 350 h.p.

St. Mary's.

Plans and specifications covering the transformer equipment and distributing system for the Town of St. Mary's were prepared by their local superintendent, and contracts were awarded after these had been approved by our Engineering Department.

During the installation of the apparatus, unlooked for difficulties occurred, and the Engineering Department was requested by the Secretary of the Hydro-Electric Committee of St. Mary's to act as consulting engineer on October 1st, 1910.

It was proposed by the town to install their transformer equipment in a building located within the town limits at some distance from the Power Commission's Station, but it was later found to be more advantageous to install this apparatus in the Commission's Station, a location which would be just as economical in regard to the efficiency of distribution and would also result in a considerable saving in electrical equipment as well as reduce the cost of operation, since one set of operators could then look after the equipment of the town and Commission. The former equipment was, therefore, installed in our transformer station, under our supervision.

Power was first received at St. Mary's on April 21st, 1910. Their maximum load during the first month of operation was 134.6 h.p., and 241 h.p. for February, 1911.

St. Thomas.

Acting in the capacity of consulting engineer for the City of St. Thomas, the Commission made a careful study of the street lighting requirements. Plans and specifications were drawn up and contracts awarded covering the necessary transformer and switching equipment, a rotary converter for the Street Railway, and the street lighting apparatus and equipment.

The work of installing this apparatus was supervised and a complete inspection of the apparatus made both at the factory prior to shipment and previous to its being placed in operation by the engineers of the Commission.

Power was first received in St. Thomas on February 23rd, 1911. The maximum load taken during the first month of operation was 134 h.p., and for the month of October, 1911, 469 h.p.

The Commission, in addition to the consulting work undertaken, purchased all necessary equipment for the distribution system, consisting of wires and other line equipment, transformers, meters, etc.

The Water Commissioners of St. Thomas later desired to purchase, through the Commission, a motor-driven low head pump, with a capacity of 2,100 imperial gallons per minute, for the new water system which they were installing. The necessary specifications were prepared, tenders received for the equipment, and after careful consideration the Commission recommended the purchase of a pump from the Canadian Böving Company. This recommendation was accepted by the Corporation, and a contract was made forthwith.

Stratford.

As consulting engineer for the Town of Stratford, the Commission prepared estimates on the cost of installing transforming and switchboard equipment and a distributing and street lighting system. A valuation was also made on the electrical plant of the Gas Company at that time supplying the town with power.

A by-law was submitted at the January elections in 1910, authorizing the issue of \$105,800 in debentures to provide for the purchase of the electrical plant of the Stratford Gas Company, and the remodelling of the system then installed, to adapt it to the Hydro-Electric power. This by-law was defeated.

A second by-law authorizing the issue of \$85,000 in debentures was submitted and carried by a large majority of the ratepayers on April 14th, 1910. This by-law provided the necessary money to purchase the poles and lines of the Gas Company, and the transformer, switching and all other equipment necessary for the distribution of Hydro-Electric power.

Specifications for all electrical apparatus to be installed by the town were submitted to the Engineering Department of the Commission for their approval, and following their installation a thorough inspection was made of the equipment prior to operation.

The question of street lighting was later carefully investigated, and recommendations were made relative to the most desirable system. Our suggestions were followed by the town in making the installation.

Power was first received from the Commission on December 25th, 1910, the maximum load taken during the first month of operation being 54 h.p., and for the month of October, 1911, 569 h.p.

At the request of the Water and Light Commissioners of the town, many prospective power-users in the town have been interviewed and the system of rates employed by the municipality explained to them. Our engineer now regularly visits Stratford one day a week.

Strathroy.

A request was received from the Mayor of the Town of Strathroy on December 13th, 1910, for estimates on the cost of supplying 100, 200, 300 and 400 h.p. to the town. Estimates were submitted, January 4th, 1911, on the cost of delivering 1,000 h.p. to Strathroy in connection with various quantities to Sarnia. It was assumed that other municipalities in that district would also desire to enter the Niagara Power Union, and consequently a total load of 1,000 h.p. could be obtained for a station located in Strathroy. (See Report on Sarnia, also on Windsor.)

Tavistock.

At the request of the Reeve of the Village of Tavistock, an engineer visited them on November 30th, 1910.

Later, at the desire of the village, estimates were prepared on the cost of supplying 200, 300, 400 and 500 h.p. to Tavistock. Together with these, other estimates were also prepared on the cost of supplying Shakespeare, the following figures being submitted for their consideration:—

- 1. Tavistock alone, the power being supplied at 13,200 volts.

200 h.p.	.....	\$40.35	per h.p.	per year.
300 "	.....	35.42	"	"
400 "	.....	32.73	"	"
500 "	.....	31.02	"	"

- 2. Tavistock and Shakespeare together, Tavistock being supplied with 13,200 volt power, and Shakespeare 2,200 volt power from a transformer station built at Tavistock:—

Tavistock	200 h.p.	.....	\$38.50	per h.p. per year.
Shakespeare	35 "	.....	45.70	" "
Tavistock	300 "	.....	34.55	" "
Shakespeare	35 "	.....	40.79	" "
Tavistock	400 "	.....	32.25	" "
Shakespeare	35 "	.....	37.83	" "
Tavistock	500 "	.....	30.70	" "
Shakespeare	35 "	.....	35.77	" "

3. Tavistock and Shakespeare both supplied with 2,200 volt power from a transformer station located at Tavistock:

Tavistock	200 h.p.	.....	\$44.22	per h.p. per year.
Shakespeare	35 "	.....	45.70	" "
Tavistock	300 "	.....	38.86	" "
Shakespeare	35 "	.....	40.79	" "
Tavistock	400 "	.....	35.63	" "
Shakespeare	35 "	.....	37.83	" "
Tavistock	500 "	.....	35.51	" "
Shakespeare	35 "	.....	35.77	" "

4. Tavistock supplied with 13,200 volt and Shakespeare with 2,200 or 550 volt power from a pole type transformer placed on the line running to Tavistock:

Tavistock	200 h.p.	.....	\$39.02	per h.p. per year.
Shakespeare	35 "	.....	38.74	" "
Tavistock	300 "	.....	34.77	" "
Shakespeare	35 "	.....	35.74	" "
Tavistock	400 "	.....	32.38	" "
Shakespeare	35 "	.....	34.11	" "
Tavistock	500 "	.....	30.78	" "
Shakespeare	35 "	.....	32.95	" "

Thamesford.

A request was received from the police Village of Thamesford on September 27th, 1910, for information in connection with Hydro-Electric power. Our representative visited the village on December 7th, 1910.

On June 27th, a letter enclosing a map of the village was received with the request that the Commission estimate the cost of supplying and distributing power to the village.

The Trustees of Thamesford were advised on July 10th, 1911, that 80 h.p. could be supplied at 2,200 volts for \$43.87 per h.p. per year. It was planned to transmit this power at 13,200 volts, and it was estimated that it could be distributed through the village at 220 and 110 volts for approximately \$5.01 per h.p. This estimate was later altered to \$48.73 for 100 h.p. to include additional equipment which the Commission considered necessary.

On October 9th the Power and Money By-laws were submitted to the voters and carried.

The contract for power was sent (in duplicate) to Thamesford for signature on October 28th.

Thornbury.

See Report on Durham District.

Thorndale.

A resolution was passed on August 8th, 1911, requesting the Commission to submit to the village an estimate on 200 h.p.

On October 11th, a copy of the Rural Act and also necessary By-laws were sent to the Police Village of Thorndale. An estimate on 200 h.p. was later prepared and submitted.

Tillsonburg.

After several visits by our representative to Tillsonburg, a power by-law for 500 h.p. at \$30.50 per h.p. per year at 13,200 volts, and a money by-law to authorize the village to raise \$25,000, were submitted to the ratepayers and carried on January 16th, 1909.

A contract was signed for 500 h.p. at 13,200 volts at \$30.50 per h.p. per year, and an estimate prepared on the cost of the transforming and switching equipment and the material required for the distributing and street lighting system.

The Council of the Town passed a resolution on September 26th, 1910, authorizing the Commission to act as Consulting Engineer for the town in connection with the purchase and erection of the necessary apparatus and material for use in the Tillsonburg sub-station. Specifications were accordingly prepared and contracts awarded for all electrical equipment required. This apparatus was installed and placed in operation on July 1st, 1911.

A number of inquiries had been received from the rural districts and villages in the vicinity of Tillsonburg for information relative to Hydro-Electric power, and investigations have, therefore, been made of the district which includes portions of the Townships of Middleton, South Norwich, Durham, also the villages of Burford, Burgessville, Otterville, Courtland and Mount Salem.

Tintern.

An inquiry was received from Tintern on September 11th, 1911, regarding the procedure to follow in applying for power.

The Commission supplied the necessary information on September 12th.

Toronto.

The City of Toronto maintains its own Engineering Department and as a result the engineering details for stations and equipment were arranged before being presented to the Commission for approval, although a number of engineering questions required our co-operation.

Arrangements were made whereby the city was permitted to install a portion of their electrical equipment in the Commission's transformer station. All apparatus installed here was approved, the original specifications being examined before tenders were called for, as well as the successful proposals, before contracts were awarded by the city. After the transforming and switching equipment had been installed in this and other stations constructed by the city, a complete

inspection was made of the entire layout covering all details of construction. All plans and specifications were examined in detail by the Engineers employed to do this work, so that they would be thoroughly familiar with the apparatus.

The City of Toronto supplies the Town of North Toronto with light and power at the same rates charged within the city limits.

The question of rates to be employed for power was discussed at great length. In preparing their schedule, the city presented a plan, and numerous examples were worked out to demonstrate the manner in which the customers' bills would be affected. After a complete and exhaustive study, and many conferences attended by the engineers of the city and Commission, a system of charges was finally approved and adopted.

Power was first delivered to the City of Toronto on March 24th, 1911. The maximum load taken during the first month of operation was 805 h.p., and for October 3,318 h.p.

Victoria Harbour.

A resolution was passed by the Council of the Village of Victoria Harbour on April 26th, 1911, requesting the Commission to submit an estimate on the cost of power supplied from the Simcoe Railway and Power Company's lines. An engineer visited Victoria Harbour on May 2nd, 1911, and interviewed the Reeve and village Clerk.

An estimate was prepared showing the cost of constructing a 25,000 volt line from the Simcoe Railway and Power Company's line, one and one-half miles to Victoria Harbour, and installing a small sub-station equipped to step down from 25,000 to 220 or 110 volts, for distributing purposes, in the village. An estimated cost of \$29.58 per h.p. per year was submitted for 100 h.p. on an assumed cost of power of \$19.00 per h.p. per year to the Commission.

Walkerville.

See Windsor.

Wardsville.

A resolution of Council was received from Wardsville on April 12th, 1911, requesting the Commission to submit estimates and other information in connection with a supply of Hydro-Electric power.

The necessary information for procedure, a blank resolution and a copy of the Rural Act were supplied them on April 21st.

Waterdown.

Estimates were prepared on the cost of supplying power to the police Village of Waterdown and the works of the Dominion Sewer Pipe Company located in the vicinity, and also on the cost of a street lighting and distributing equipment for the village. These estimates were submitted to the village and the Company for their consideration, and a contract between the Dominion Sewer Pipe Company and the Commission for 150 h.p. at 2,200 volts at \$32.50 per h.p. per year was drawn up and signed on September 19th, 1911. (See contracts with Municipalities).

A by-law was submitted and signed by the ratepayers of Waterdown on May 22nd, 1911, authorizing the Municipal Council of the Corporation to contract for a supply of electrical power from the Commission.

Waterloo.

A resolution was passed on October 22nd, 1909, by the Town Council of Waterloo, requesting the Commission to act as Consulting Engineer for the Town. Specifications for the necessary electrical apparatus to be installed by the town were submitted to the Commission for approval. After installation the equipment was inspected and power delivered on November 13th, 1910.

A schedule of rates has been prepared by the town, submitted to the Commission for approval, and adopted.

Welland.

Application has been received from the Town of Welland asking for an estimate on the cost of supplying 200 h.p. The application is now under consideration.

Weston.

Application was received from the Village of Weston for an estimate on the cost of supplying 250 h.p., and a figure of \$29.25 per h.p. per year was submitted for their consideration. A second estimate was submitted October 1st, 1910, covering the cost of the necessary apparatus and materials for adapting the present system for Hydro-Electric power. A contract for 250 h.p. at the above price was signed in June, and Messrs. Mitchell and Mitchell were appointed consulting Engineers for the Village, to prepare specifications on the transforming and switching apparatus and plans for the station. After contracts had been awarded, the Engineering Department of the Commission was appointed Consulting Engineers, and acting in this capacity supervised the installation of all apparatus. Our representative spent at least one day a week in the village inspecting the constructions in their various stages, and at the same time arranged the work in connection with the local distribution system. The Purchasing Department of the Commission acted as Purchasing Agent for the supply of all materials required for the distribution system such as poles, wire, and other line material, transformers, meters, street lighting brackets, etc.

A schedule of rates, which is a modification of the City of Toronto system, for power and light was prepared, submitted to the Commission for approval, and adopted.

Power was first delivered to the Village of Weston on August 4th, 1911. Their maximum load for the last current month was 80 h.p.

Warton.

An application was received from the Town of Warton for an estimate on a supply of 1,600 h.p. Conditions here are being investigated in connection with those in other municipalities in the Georgian Bay District. (See Report on Durham District.)

Woodstock.

Though the engineering in connection with the installation of equipment for the use of the town was taken care of by a firm of Consulting Engineers, yet all details were referred to the Commission for approval. Arrangements were also made for the town to instal a portion of their equipment in the Commission's transformer station. A great many other details were brought up and disposed of satisfactorily, among others being the question of rates.

Power was first delivered to Woodstock on November 30th, 1910, their load for the first month of operation being 450 h.p. During the last current month the City of Woodstock took 804 h.p. from the Commission's lines.

Yarmouth Township.

Application for power was received from this township on July 8th, 1911. An engineer visited the district on August 1st, 1911, and requested additional information. Later, on August 31st, a letter was sent to the Township Clerk requesting information, which, as yet, has not been received.

York Township.

A resolution was passed on June 6th, 1911, by the Council of York Township, requesting the Commission to submit estimates on the price of power for that district. The Commission advised on June 7th, that more information was required and enclosed copies of the Rural Act.

Department of Public Works.

Hamilton Asylum.

We were requested by Mr. E. R. Rogers, Inspector of Asylums, on December 28th, 1909, to send one of our engineers to the Hospital for the Insane at Hamilton to examine the building and grounds with a view to using electric energy for light as soon as it could be supplied by the Commission.

An engineer was sent on January 11th, 1910, to investigate conditions at this Institution, and on January 27th a report was submitted to the Department of Public Works containing an estimate on the cost of adapting this plant for Hydro-Electric power. The estimate covered the cost of installing the necessary apparatus to replace the steam pumps, steam and gas engines then in use, and supplying energy for lighting. The capacity of the station and equipment was figured at 200 h.p. and provision made for additional equipment required by a future load resulting from the use of elevators and ventilating apparatus.

It was proposed to install the station equipment in the Queen Street Pumping Station with the exception of the constant current transformer for outside lighting which was to be placed in the fire-hall. A three-stage turbine pump direct connected to a 2,200 volt motor was to be employed to replace one of the steam pumps, this would be controlled by an automatic float switch at the upper reservoir since it was intended to pump directly from the city main instead of from the tank. The line switch was to be electrically operated from a convenient point at the main building. By this arrangement it would be possible to dispense with an attendant at the Queen Street pump-house.

A direct connected centrifugal pump and motor were to be installed for pumping from the reservoir to the various tanks, and one of the present steam pumps held as a reserve since high pressure steam was required in the building and thus steam would be available at all times for this and also for the steam fire pump.

It was further suggested to the Department that one of the boilers at the Queen Street pump-house could be heated with gas. The following estimates were prepared, showing the saving which might be affected by the use of Hydro-Electric power, and the expense of adapting their plant, and forwarded to the Provincial Secretary on January 27th.

Present cost of power for incandescent and arc lamps, and a	
1 h.p. motor	\$3,187 00
Coal and labour at Queen Street pump-house	1,790 00
Gas for bakery gas engine	24 00
Coal for laundry	450 00
Coal for pumps	325 00
Arc lamps, carbons and trimming	50 00
Oil, waste and repairs	100 00
Total cost of power and light	\$5,926 00
Annual cost for Hydro-Electric power:—	
100 h.p. at \$23.00	\$2,300 00
100 Tungsten lamps at \$1.50	150 00
Depreciation on apparatus and line required	721 00
Total cost of power and light	\$3,171 00
Net saving by using Hydro-Electric power	\$2,755 00

Total capital cost estimated for installation of Hydro-Electric power	12,043 00
Extra for the line from the old to the new farm buildings, including new interior wiring and fixtures	2,350 00
Total estimated cost of installation	\$14,393 00

ESTIMATES ON COST TO ADAPT PLAN FOR NIAGARA POWER STATION AND EQUIPMENT.

Estimates cover transforming equipment at Queen Street pump-house with 2,200 volt lines from there to Asylum. Two turbine pumps are included to replace present steam pumps, and motors for bakery and laundry, to replace gas and steam engines respectively. No fire pump is included.

	Capital Cost.	Per Cent.	Depreciation.
Addition to pump house.....	\$800	2	\$16
Incoming 13,200 volt line panel	1,000	6	60
Lightning arrester equipment	700	6	42
2 2,200 volt feeder panels	800	6	48
3 50 kw. transformers, 13,210/2,200	2,100	6	126
	\$5,400	.....	\$292

ADDITIONAL APPARATUS REQUIRED.

1 259,000 gal. turbine pump, 140 lb. pressure, 35 h.p., 2,200 volt; motor, direct connected, installed.....	1,300	6	78
1 250,000 gal. turbine pump, 50 lb. pressure, 15 h.p. 110 volt; motor, direct connected, installed.....	900	6	54
3 15 kw. transformers, 2,200/110 volt, installed at \$225.00.....	675	6	41
6 10 kw. do. do. do. \$190.00.....	1,140	6	68
6 5 kw. do. do. do. \$110.00.....	660	6	40
1 C.C. regulating transformer, 4 kw., with control panel, installed.	550	6	33
50 series lamps, brackets and shades, installed at \$10.00.....	500	6	30
1 5 h.p. 110 volt motor for bakery, installed.....	95	6	6
1 25 h.p. motor for laundry, installed	500	6	30
2,200 volt line from Pumping Station to Asylum, $\frac{3}{4}$ mile, No. 4 copper, 2 circuit.....	900	8	72
Line from old to new farm buildings, 1 mile, using present telephone poles with extensions to same	500	8	40
New inside wiring and fixtures.....	1,500	6	90
Repairing present wiring.....	500	6	30
New lines for street lighting and distribution.....	400	8	32
	\$10,120	.....	\$644
Station and equipment (brought forward).....	5,400	.....	292
	\$15,520	.....	\$936
Engineering and contingencies, 12 per cent.....	1,862	.....	112
	\$17,382	.....	\$1,048
Interest during construction, $1\frac{1}{2}$ per cent.....	261	6	16
	\$17,643	.....	\$1,064

We were advised on April 7th by the Department of Public Works that an appropriation of \$12,000 had been granted for the work at the Hamilton Asylum for the Insane.

Specifications were then prepared covering station and service transformers, switching and protective apparatus and two motor driven turbine pumps, and approved by the Deputy Minister of Public Works on August 9th.

They were then forwarded to the following:—

The Canadian General Electric Company, Toronto.

The Canadian Westinghouse Company, Hamilton.

Allis-Chalmers-Bullock, Ltd., Montreal.

The Central Electric and School Supply Company, Toronto.

Messrs. Chapman & Walker, Toronto.

Messrs. Kilmer, Pullen & Burnham, Toronto.

Siemens Bros. Dynamo Works, Toronto.

Ferranti, Ltd., West Toronto.

The Packard Electric Company, Toronto.

The Lancashire Dynamo and Motor Company, Toronto.

The Northern Electric and Manufacturing Co., Toronto.

The Sunbeam Incandescent Lamp Company, Toronto.

The Canadian Buffalo Forge Company, Montreal.

The Gould Pump Company, Ltd., Toronto.

The Smart Turner Machine Company, Ltd., Hamilton.

The tenders received for equipment at the Hamilton Asylum were forwarded on September 8th, after careful consideration, with our recommendations, to the Department of Public Works for their approval. Contracts for the apparatus were awarded to the Canadian Westinghouse Company, Hamilton, for \$6,070, and signed March 11th, 1911.

The proposed arrangement of the apparatus in the Queen Street station pump-house was forwarded to the Canadian Westinghouse Company on March 25th, to assist them in the wiring lay-out.

We received permission on May 9th from the City of Hamilton to connect the three-inch turbine pump in the Queen Street pump-house direct to the City main.

During July and August changes were made in the Queen Street sub-station to adapt it for the electrical equipment and turbine pump. All electrical apparatus and pumps were installed and in use by November 1st. The inspection of this work was attended to by a representative who spent one day a week on the work.

The following work has also been accomplished by our linemen:—

Wiring in conduit for lighting the Queen Street pump-house.

Pole line from the pump-house to the Asylum by way of Queen Street.

Erection of new lighting system for the grounds.

Pole line to Hickory Farm.

Removing the old 60 cycle service transformers, erecting the new 25 cycle service transformers and making two wire secondary connections to building.

Wiring for lighting the bowling green.

No appropriations were made during the year to secure the necessary changes in the wiring to place it in first-class condition, although this action was advised, but it is understood that measures will be taken to provide for these changes next year.

Ontario Agricultural College.

We received a request from the Provincial Department of Agriculture on December 29th, 1909, asking that a report be submitted, giving an estimate on the cost of the changes necessary to adapt the plant of the Ontario Agricultural College for Hydro-Electric power.

The following estimate was forwarded to the Deputy Minister of Agriculture on January 27th, 1910:

ESTIMATE FOR ONTARIO AGRICULTURAL COLLEGE.

Assuming that a branch 13,200 volt line be run to the College, the equipment needed would be as follows:—

Items.	Capital Costs.	Per Cent.	Annual Charges.
1 three-phase 13,200 volt set of lightning arresters.....	\$375	6	\$23
1 set of 3 disconnecting switches for 13,200 volts.....	51	6	3
1 set of 3 choke coils for 13,200 volts.....	123	6	7
3 50 kw. 13,200-220 volt transformers, O.I.S.C. at \$675.....	2,025	6	122
1 13,200 volt incoming line panel.....	600	6	36
Since d.c. motors are now installed we would advise maintaining the direct current system and therefore the following equipment would be needed to convert the 220 volt a.c. to 220 volt d.c.			
1 100 kw. motor generator set, induction motor and 200 volt 100 kw. direct connected generator	4,200	6	252
1 50 h.p. 220 volt, 720 r.p.m. induction motor to drive present belted 30 kw. d.c. generator	800	6	48
(The two steam driven 50 kw. units to be retained for peak work in winter and possible reserve.)			
To replace the isolated steam plant in the dairy stables we would advise:			
1 8 h.p. 1,475 r.p.m., d. c. motor to drive compressor.....	155	6	9
1 10 h.p., 1,250 r.p.m., d.c. motor for other work now done by engine	215	6	13
To replace the steam equipment now in use at the main building, we would advise:			
1 a.c. motor driven compressor (90 lb. per sq. in.).....	2,000	6	120
1 10 h.p., a.c. motor driven pump (7,000 gal. per hr. against 70 lb.)	900	6	54
1 a.c. motor driven pump (500 gal. per min. against 125 lb.) for fire purposes	2,000	6	120
1 15 h.p., a.c. motor to drive the present ice machine.....	350	6	21
	\$13,794	.....	\$828
Engineering and contingencies at 12 per cent.....	1,655	.....	99
	15,449	.....	927
Interest during construction, at 1½ per cent.....	231	6	14
Total capital cost	\$15,680	.....	\$941

This estimate was later supplemented by the following report on February 8th, resulting from further investigations:—

REPORT ON THE SAVINGS TO BE EFFECTED BY EMPLOYMENT OF ELECTRICAL ENERGY AT ONTARIO AGRICULTURAL COLLEGE.

The present power plant at the Main Building furnishes electric light and power for the entire College, twelve months of the year, and also pumps all water required by the College for the same period. The exhaust steam from these engines is used to heat the Main Building during eight months of the year. Live steam is used from this plant to heat the Chemical Building, Library, Physics Building, two dwellings and the Gymnasium for eight months of the year.

The three McDonald Buildings are heated by a separate plant.

The Horticultural Building has a hot water plant. The Dairy has a small steam plant.

The average Coal bills for the various plants are:—

Main Plant	\$12,989 00
McDonald Buildings	2,980 00
Dairy ..	830 00
Horticultural Buildings	680 00
Total . . .	\$17,479 00

We propose to operate the generators, pumps, compressor and ice machine at the Main Plant by motors, and to replace the engine at the Dairy with motors.

The following figures represent the estimated saving to be effected by the use of Hydro-Electric power in this institution:—

Saving in coal at main plant, 2,168 tons at \$4.13	\$8,954 00
Less heating value of exhaust steam	2,980 00

Saving . . .	\$5,974 00
Saving in labour, one man	640 00
Saving in oil and waste	150 00
Saving in coal at Dairy	430 00

Gross saving	\$7,194 00
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Cost of Hydro-Electric power, present peak load 88½ h.p.;	
88½ h.p. at \$32.00	\$2,832 00
Depreciation on entire equipment proposed	941 00
	\$3,773 00

Net saving effected by using Hydro-Electric power	\$3,421 00
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Estimated cost of equipment necessary for installation of Hydro-Electric power	\$15,680 00
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President Creelman recommends that some outside lighting be included in the estimate. This can easily be accomplished to the extent suggested, and readily furnished, at an initial cost of \$100.00.

We were advised on April 7th by the Department of Public Works that \$15,000 had been appropriated for adapting this plant for the use of Hydro Electric power.

At the suggestion of Mr. Green, the Engineer of the College, we prepared and submitted the following supplementary recommendations to the Provincial Department of Public Works on August 29th, 1910:—

SUPPLEMENTARY RECOMMENDATIONS ON SPECIFICATIONS AND APPLICATIONS FOR TENDERS FOR ONTARIO AGRICULTURAL COLLEGE.

- One set of 13,200 volt lightning arresters.
- One set of 13,200 volt disconnecting switches.
- One set of 13,200 volt choke coils.

Three 75 kw. 13,200-220 volt transformers.

One 13,200 volt incoming line panel.

All of this additional equipment to be installed in the present Dynamo room.

One motor generator set consisting of one 100 kw. 220 volt d.c. generator, direct connected to a 220 volt synchronous motor, together with the necessary starting equipment.

One 25 kw. 220 volt generator, direct connected to a 220 volt induction motor with the necessary starting equipment.

(The present belt driven 35 kw. generator is very old, and the capacity low. In order to carry the light load late at night and through the day-time a 25 kw. set would be much more efficient than a large one.)

One motor driven Compressor to replace the present steam driven compressor in the dairy stables. The present compressor is 10 in. diameter with 10 in. stroke, pumping against 45 lb. at about 40 r.p.m. This capacity not to be increased. The motor to be 220 volt direct current.

One 10 h.p. 220 volt d.c. motor to replace present steam engine.

One motor driven compressor, 25 per cent. greater capacity than the present steam driven compressor, which is of 12 in. diameter, with an 18 in. stroke, pumping against 85 lb. at about 90 r.p.m. This compressor to pump from the deep well.

One motor driven pump for general service work, with a capacity of 8,000 gallons per hour against 70 lb. to replace the present service pump, and to connect with the present suction and discharge pipes which should both be 4 inches.

One motor driven fire pump, with a capacity of 500 gallons per minute against a pressure of 125 lbs. The present steam driven fire pump to be retained as an auxiliary for all services. The new pump should have a 6 in. suction and a 6 in. discharge.

One motor driven ice machine, with a direct current motor of sufficient capacity to drive the present ice machine, two circulating pumps and one fan.

Two motor driven boiler feed pumps, with a capacity of 200 gallons per hour. (This item is added at the request of Mr. Green, the Engineer.)

Specifications covering the station transformers, switching and protective apparatus, two motor generator sets, two electrically driven air compressors, two electrically driven turbine pumps and two electrically driven rotary boiler feed pumps; also form of tender and instructions to bidders were prepared for the College and forwarded on September 14th to the Department of Public Works for their approval.

A list of the manufacturers to whom applications for specifications were to be forwarded were also supplied.

After these specifications had been approved by the Department of Public Works they were forwarded to the following firms and tenders called for not later than 5 o'clock, October 5th:

Canadian General Electric Co., Toronto.

Canadian Westinghouse Company, Hamilton.

Allis-Chalmers-Bullock, Limited, Toronto.

Chapman & Walker, Toronto.

Kilmer, Pullen & Burnham, Toronto.

The Siemens Bros., Dynamo Works, Toronto.

The Packard Electric Company, St. Catharines.

The Lancashire Dynamo and Motor Company, Toronto.

The Gould Pump Company, Toronto.

The Canadian Rand Company, Toronto.

Our recommendations for the placing of contracts for the electrical and pumping apparatus for the College were forwarded, after careful consideration, to the Department of Public Works on November 26th, for their approval, and on December 16th, we were asked to draw up the contracts in proper form.

Contracts for the above apparatus were awarded as follows:—

Transformers—The Packard Electric Company, St. Catharines	\$2,000 00
Switching apparatus—Siemens Bros. Dynamo Works, Toronto	2,500 00
Motor Generator sets and D.C. Motors—Kilmer, Pullen & Burnham, Toronto	6,407 75
Lightning Arresters, etc., Air Compressors and Pumps—Canadian General Electric Co., Toronto	4,681 00

These contracts were signed the first part of March, and drawings indicating the necessary changes in the present electrical lay-out, in addition to the changes to the old building, were forwarded to the Department of Public Works.

The wiring lay-out for the above apparatus was forwarded to the different contractors in March, and the numerous engineering details of work supervised by our Engineering Department.

An Engineer was sent to the Packard Electric Company on July 25th, to witness the tests on the three 75 kw. sub-station transformers. The tests were approved and the transformers ordered shipped immediately. Tests were also witnessed on the domestic and fire pumps at the Canadian General Electric Company's works and these were also ordered shipped in September.

During August, September and October our Engineer spent one day a week in Guelph inspecting the construction work.

The installation of the sub-station apparatus was rushed and at the end of October we estimated that all equipment, with the exception of the pumping apparatus, would be ready for operation on November 15th.

London Asylum.

At the request of the Department of Public Works, an engineer was sent in January, 1910, to the Hospital for the Insane at London, Ont., to secure sufficient information for an estimate on the cost of adapting the plant for Hydro-Electric power.

The following estimate was submitted to the Provincial Secretary on January 24th.

ESTIMATE FOR LONDON ASYLUM.

	Capital Cost.	Per Cent.	Annual Charges.
Assuming that the Asylum is supplied with power by a 13,200 volt line run from the H.E.P. Commission's station to the West gate of the Asylum Grounds, the equipment needed would be as follows:—			
1,200 ft. of 13,200 volt line in Asylum Grounds at \$500.00 per 1,000 ft.....	\$600	6	\$36
Building—proposed sub-station 30 ft. by 32 ft. by 16 ft. high..	2,500	2	50
1 set of 13,200 volt lightning arresters.....	375	6	23
1 set of 13,200 volt choke coils.....	200	6	12
1 set of 13,200 volt disconnecting switches.....	125	6	8
3 single phase 13,200-2,200 volt transformers, 50 kw. each.....	2,025	6	122
3 single phase 13,200-575 volt transformers, 30 kw. each.....	1,500	6	90
1 575 volt feeder panel for motor circuit.....	350	6	21
2 2,200 volt feeder panel, for lighting.....	800	6	48

ESTIMATE FOR LONDON ASYLUM.—Continued.

	Capital Cost.	Per Cent.	Annual Charges.
Using a 2,200 volt distribution to the various buildings for lighting and small power, such as ventilators, and stepping down to 110-220 volts for three wire distribution at each building, the following transformers will be needed :—			
Main building and adjacent buildings, 3-30 kw. trans.....	1,050	6	63
Hospital, 1-25 kw. trans	300	6	18
North building, 1-25 kw. trans.....	300	6	18
Houses and out-buildings, { 2-5 kw. trans.....	100	6	6
{ 3-2 kw. trans.....	100	6	6
The cost of wiring the various buildings would be as follows: Conduit is recommended since it is the only safe construction, but if concealed it would require too much ripping up of the floors, etc., so we have estimated on exposed conduit:			
Wiring of main building with fixtures (743 outlets).....	5,575	2	112
Infirmary (wiring and fixtures already in place) additional cost for wiring for motors.....	75	2	2
Wiring of north building, refractory wards (380 outlets).....	2,850	2	57
Bursar's house.....	125	6	8
Church (without fixtures).....	113	2	2
Coal sheds.....	40	6	3
Root house.....	30	6	2
Entrance lodges.....	42	6	3
Piggery	25	6	2
Slaughter house and barns.....	180	6	11
Workshops	90	6	5
Skating rink.....	45	6	27
Laundry.....	120	2	2
Stables and coach house	50	2	1
Cottage for butcher.....	66	6	4
Storehouse	70	6	4
3 cottages (52 outlets, each at \$350.00)	1,170	2	23
Medical superintendent's residence.....	180	2	4
Hothouse	80	6	5
Extra for power purposes through various buildings.....	490	2	10
In order to replace present steam equipment operating at great disadvantage at various places we would recommend the installation of the following equipment :—			
1 motor for sewerage pump.....	450	6	27
1 motor for laundry.....	450	6	27
1 motor driven fire pump, capacity for 3-1½ nozzles at 116 lb. 100 h.p. motor 2-stage pump.....	2,800	6	168
1 motor for ash hoist in boiler room.....	125	6	8
1 motor for blower in boiler room.....	125	6	7
1 motor for machine shop.....	125	6	8
1 motor for kitchen fan.....	95	6	6
1 motor to drive mixer in bake shop.....	250	6	15
1 motor to drive picking machine.....	95	6	6
1 motor for carpenter's mill	390	6	23
1 motor to drive dryers in laundry	125	6	7
1 motor to drive mangle in laundry.....	230	6	13
1 motor for kitchen coffee mill, etc	80	6	5
1 motor for ice cream freezer, etc.....	95	6	6
2 motors for dumb waiters (in main building).....	150	6	9
1 motor for passenger elevator, car, motor, etc.....	450	6	27
2 dumb waiter motors (in infirmary).....	150	6	9
2 dumb waiter motors (in north building)	150	6	9
1 motor for feed cutter	125	6	8
1 motor for feed grinder.....	340	6	20
1 motor for sausage machine.....	85	6	5
20 irons in store rooms and cottages.....	70	10	7

ESTIMATE FOR LONDON ASYLUM.—*Continued.*

	Capital Cost.	Per Cent.	Annual Charges.
40 irons in laundry.....	140	10	14
15 small electrical cookers.....	120	10	12
5 ceiling fans in main kitchen.....	175	6	11
1 ceiling fan in hospital.....	35	6	2
1 ceiling fan in north building kitchen.....	35	6	2
12 18-in. ventilating fans.....	780	6	47
15 12-in. ventilating fans.....	675	6	41
1 motor and compressor for two deep wells, each to give 100,000 gallons per day, 75 foot lift.....	1,800	6	108
For lighting grounds and drives, two miles of series tungsten lighting would be required.			
The station apparatus and line material required for the outside lighting and for the 2,200 volt distribution would be as follows:—			
1 4 kw. regulating transformer, 2,200 volts with control panel..	550	6	33
50 series lamp brackets and shades installed at \$10.00.....	500	5	30
2,200 lb. No. 6 wire for lighting and 2,200 volt distribution, erected at 20 cents.....	440	2	9
88 30 ft. poles with cross arms and insulators complete, erected at \$11.00.....	968	8	77
	\$34,914	.....	\$1,614
Engineering and contingencies, 12 per cent	4,190	.....	194
	\$39,104	.....	\$1,808
Interest during construction, 1½ per cent	587	.....	27
	\$39,691	.....	\$1,835

The Provincial Secretary was further advised on February 8th, as follows:—

The buildings of the Asylum are at present lighted by gas, coal-oil lamps and lanterns. The gas pressure has been a subject of complaint ever since the system was installed. The attendants use lanterns on their table to see to eat, and the patients cannot read or play cards after nightfall until the load becomes lighter and the pressure rises. The barns with their stock and supplies of hay and grain are lighted only by the attendants' lanterns. The value of stock here alone often exceeds \$7,000.00. The patients ignite strips of paper in the gas jets to light their pipes, and then drop the burning paper on the floor. A large number of fires are reported, but fortunately none have so far proved disastrous. A more complete report relative to the fire hazard may be obtained from Captain Crawford, who recently made an inspection of the Asylum. None of the patients' rooms have light, and the attendants carry lanterns during the night. The entire gas installation should be overhauled, if further employed, since it is antiquated, inefficient, unsafe, and does not possess sufficient capacity to provide for extra lights desired.

At present there are only about four lamps situated outside the building. Additional lights should be installed for safety and police purposes.

The ventilation in the wards, halls and lavatories is bad, and motors to ventilate these should be installed.

The present steam equipment is old, the pumping engine having served since the Asylum was built.

The sewage, laundry and water-works engines are 25 to 30 years old, and the barn engine, which is 16 years old, is in bad condition, and the boilers should

be replaced by some with greater capacity. The main building is heated by old inefficient boilers fired by hand. Were the power requirements removed from the new boilers, they would furnish all the steam heat needed not only by the main building but also by the cottages. The Superintendent's house, and the hospital are heated by separate equipments.

The laundry now requires two stoves to heat the flat irons, and the coal consumed, which amounts to half a ton a week, must be carried by hand to the Laundry.

The only need for steam at present, outside of that required for the engines, is in the kitchen, where live steam is used for cooking purposes and the return utilized to heat the water for the lavatories and baths.

The annual cost of gas in 1908 was \$4,522.00; for the ten months ending October 30th, \$3,522.00, which will be further increased by the consumption for the two heaviest months, and an annual charge of \$200.00 for a governor. Six barrels of coal-oil, at \$8.50 a barrel, are used a year.

The annual cost of coal in round numbers is \$14,000.00 This varies slightly from year to year. Slack at \$3.25 a ton delivered, and hard coal at \$5.00 to \$6.25 a ton delivered is used. During July 61,600 lbs. of this coal are consumed per week, and 124,400 lbs. per week in December at the main plant. The difference between the two for six months is chargeable to heating, or one-third of this consumption. Some of the consumption is chargeable to cooking, etc. Allowing this, on a generous assumption, as 25 per cent., we find the power cost in coal to be 61,600 lb. by 52 weeks by 75 per cent. at \$3.25 = \$5,205.00.

Another saving could be effected by using 485 tons of slack at \$3.25 in the main plant for heating purposes in the Hospital, cottages, and superintendent's residence instead of 485 tons of hard coal now used at \$6.25 per ton, less 100 tons consumed for cooking purposes. 385 tons at \$3.00 = \$1,155.00

The coal used in the laundry stoves—one-half ton per week at \$6.25 per ton, would be saved.

26 tons at \$6.25 = \$162.00.

The saving in labour (very conservative) would be:—

One man at \$30.00 for 12 months = \$360.00.

A saving in engine oil, two (2) barrels at \$28.00 = \$56.00 would also result.

The aggregate of the above items, which are the direct savings, would be \$11,511.00.

The comparative cost for electric power would be:—

Say, 175 h-p. at \$32.00	\$5,600 00
Depreciation (see estimate)	1,835 00

\$7,435 00

Or a saving of \$4,076.00 per year.

Many reasons for making this installation have already been mentioned. but we would add a few features which are not included in the comparative costs.

We include the cost of a fire-proof building, in which the electrical apparatus and the fire pumps will be placed since the fire pump is now in a dangerous location.

We have estimated on 2,500 lamps in comparison with the 1,100 to 1,200 now in service.

We have included apparatus which is needed for a second deep well.

We have included a complete lighting system for the roads and walks of the grounds, between the buildings, etc.

We have estimated on lamps that will give full rated candle power per lamp, and not lamps such as at present are used.

We have estimated on motor horse power for apparatus needed but which is not operated due to lack of power.

The patients should have light to read by so that they may enjoy the hours after dark. Electric lamps would offer reduced fire hazard, and lastly we have estimated on safe and fire-proof wiring.

There is every reason for the installation, with only the one objection, that of first cost.

We were advised by the Deputy Minister of Public Works on April 7th, that \$25,000.00 had been appropriated for adapting this plant for Hydro-Electric power and were asked to have the engineering department begin the work as soon as possible.

We advised the Department of Public Works on May 2nd that we required blue prints of the various buildings in preparing our plans and specifications and in outlining the work to be done, and asked them to forward to us blue prints of all the buildings.

We also pointed out that the appropriation for the London Asylum was less than the estimated cost of the apparatus and the wiring which was included in our estimate, and asked for their advice as to what part of the apparatus and wiring they wished installed with the appropriation allowed.

The Department of Public Works requested us on January 4th, 1911, to prepare specifications on the requirements of the London Asylum for use of Niagara power for lighting the buildings and grounds and for the installation of electric power:—

They proposed to install 1,500 16 c.p. lamps, and 118 32 c.p. lamps for lighting the several buildings and grounds; electric power in pumping the water supply; an additional fire pump and also one for pumping sewage from the receiving tank to the receiving farm; motors to drive machines in the barn, machine shop, carpenter shop, laundry, the kitchen fan and the ash hoist.

When laying out the interior wiring and the outside wiring, we requested advice from the proper authorities regarding the locations, number and sizes of lamps and the equipment which they desired.

When preparing our plans for the construction of the transmission line from the station east of London to the London Asylum, we pointed out to the Department of Public Works that from Dundas St. to the side gate of the Asylum the road was lined with very heavy trees, principally maples, which would necessitate our using very high poles or else considerable trimming to prevent the trees interfering with the line, and asked their permission to erect the pole line across the asylum field: that is, from Dundas Street to the west side gate. We received permission on May 9th to place the poles in the Asylum field.

In planning the terminal station for the line from the Commission's station to the Asylum, we suggested the construction of a fire-proof building and pointed out that this station would contain the high tension lightning arresters and line equipment, the stepdown transformers, control apparatus, and would also be large enough to provide for the installation of a motor-driven service pump and a motor-driven fire pump, and also provide for future extension.

After being prepared, specifications on the wiring material for the various buildings were submitted and tenders called for, with the permission of the Department of Public Works, from the following:—

Eugene F. Phillips, Montreal.

R. E. T. Pringle & Co., Montreal.

John Forman Electric Supply Co., Montreal.

Conduits Co., Ltd., Toronto.

A. E. Greene & Co., Toronto.

C. W. Bongard & Co., Toronto.

Can. Johns Manville, Toronto.

Chapman & Walker, Toronto.

Keith and Fitzsimons, Toronto.

Central Electric and School Supply Co., Toronto.

Northern Electric and Mfg. Co., Toronto.

Can. General Electric Co., Toronto.

Rogers Electric Co., Toronto.

McDonald & Willson, Toronto.

The schedule of tenders received on the wiring material, together with our recommendation, was forwarded to the Department of Public Works on May 20th and upon securing their approval, the contract was awarded to the Canadian General Electric Co., Ltd., Toronto.

Specifications were prepared for the sub-station equipment, consisting of station transformers, switching and protective apparatus, motors, service transformers and pumping apparatus, in May, and one copy was forwarded to the Department of Public Works on May 18th for their approval. Approval was received on the same date.

Specifications, Form of Tender and instructions to Bidders, covering this apparatus, were forwarded to the following on May 19th:—

Central Electric & School Supply Co., Toronto.

Alfred Collier & Co., Montreal.

Gould Pump Co., Toronto.

Canadian General Electric Co., Toronto.

Canadian Westinghouse Co., Toronto.

Allis-Chalmers-Bullock, Ltd., Toronto.

Canadian Crocker-Wheeler Co., St. Catharines.

The Packard Electric Co., St. Catharines.

Siemens Bros'. Dynamo Works, Ltd., Toronto.

Kilmer, Pullen & Burnham, Toronto.

Chapman & Walker, Toronto.

Vandeleur & Nichols, Toronto.

Northern Electric and Mfg. Co., Toronto.

After careful consideration, our recommendations relative to the awarding of contracts for this apparatus were forwarded to the Department of Public Works on June 8th, and, with their approval, contracts for apparatus were awarded as follows:—

The Step-down Transformers and Service Transformers were awarded to the Canadian Crocker-Wheeler Co., St. Catharines, for \$2,800.00.

The Switching Apparatus, Lightning Arresters, Motors, Domestic Pump and Sewage Pump, were awarded to the Canadian General Electric Co., Ltd., Toronto, for \$5,822.00.

The Fire Pump and Motor were awarded to Chapman & Walker, Toronto, for \$1,400.00.

During July, detail drawings for the construction of the sub-station were forwarded to the Department of Public Works, the erection being started in the latter part of the month. A weekly inspection was made by one of our Engineers while the work was in progress.

Our engineer visited the works of the Canadian Crocker Wheeler Co., St. Catharines, to witness tests of the three 75 kw. transformers on September 29th. The transformers successfully withstood the tests, and on October 3rd we ordered that they be shipped immediately.

The sub-station structure was finished by October 15th.

All the transformers, about one-half of the motors, as well as part of the switching apparatus, had been received at the Asylum by October 31st, and approximately 75 per cent. of the wiring of the various buildings completed, and material erected for the lighting system about the grounds.

Kingston Asylum.

At the request of the Department of Public Works, an Engineer was sent to Kingston on August 10th, 1911, to ascertain the cause of a fire in the basement of the main building, and on August 11th a report was forwarded to the Deputy Minister of Public Works advising that this fire was caused by the local telephone wire coming in contact with a trolley wire, the blowing of the open linked fuses on the telephone rack in the battery room having set fire to the pine board on which they were mounted and partially destroying about thirty square feet of wall and ceiling as well as all the telephone wires in this room.

The report also pointed out that numerous changes were necessary in the present wiring so that it would conform to the Underwriters' requirements and suggested that an experienced wiring foreman be placed in charge of the repair work at the Asylum so that all the wiring could be placed in first-class condition as soon as possible.

Mimico Asylum.

At the request of the Department of Public Works an engineer was sent to Mimico Asylum in February, 1910, to examine the lay-out and prepare a report on the estimated saving which might be secured by adapting the plant for Hydro-Electric power.

The following report was submitted, giving the estimated saving in present annual charges:—

Allowance has been made for the heating value of the exhaust steam.

Pump House:—

160 tons coal at \$3.60	\$576 00	
Labor	575 00	
House at \$10 per month	120 00	
		<hr/>
		\$1,271 00

Lighting Station:—

408 tons coal at \$3.60	\$1,469 00	
Labor	480 00	
		<hr/>
		\$1,949 00

Small Engine

Estimate, based on average load of 30 h.p. 2,000 hr. per year	}	\$583 00
162 tons coal at \$3.60		
Arc Lamp Carbons and Trimming		50 00
Saving in oil, Waste and Repairs		100 00
Total		\$3,953 00
Annual Cost for Hydro-Electric power, 100 h.p. at \$30.00		\$3,000 00
80 Tungsten Lamps at \$1.50		120 00
Total		\$3,120 00

We were advised by the Department of Public Works on April 26th, 1911, that \$10,000 had been appropriated for adapting this plant to Hydro-Electric power, and were asked to forward a report on the work required at the institution to adapt it to 25 cycle power.

Our engineer visited Mimico Asylum on May 22nd to examine the present electric and pump equipment, and the following report was submitted with an estimate of the cost of the installation of 25 cycle apparatus and pumps for this institution:—

REPORT ON MIMICO ASYLUM.

The following is an estimate on the installation of 25 cycle apparatus and pumps at the Mimico Asylum, to adapt the plant to Hydro-Electric power:—

Switchboard, including ammeter and plug; voltmeter and plug; 2 series transformers; 2 potential transformers; graphic watt- meter; oil switch and 3 two-pole single-throw knife switches, 60 amp. and fuses, mounted on oiled slate panels	\$675 00
Three 15 kw. 2200/220/110 volt lighting transformers	700 00
Three 15 kw. 2200/550 volt motor transformers	700 00
One 10 kw. 2200/220/110 volt lighting transformer	125 00
One Fire Pump and motor, 2,200 volts	1,850 00
One Sewage pump and motor, 550 volts	350 00
One Domestic pump and motor, 550 volts, with automatic starter	950 00
Single-pole lightning arresters	100 00
Two 15 h.p. motors, 550 volts, laundry and shops	700 00
Lighting grounds and Lake Shore road	2,800 00
Lines to pumps	800 00
10% for engineering and contingencies	975 00
Interest during construction, 1½%	161 00
Total	\$10,886 00

To take care of the sewage, we advise installing one vertical centrifugal pump direct-connected to a 550 volt motor, the recommended capacity of pump to be 125 Imperial gallons per minute. This pump should be installed in the well 12 feet deep.

For domestic supply of water we recommend a 250 Imperial gallon per minute turbine pump to work against a total dynamic head of 110 feet, including a maximum suction lift of 11 feet, through 2 ft. 10 in. elbows installed with the present filter. The filter would add 5 lb. pressure when 134 gal. per minute are passing through, and approximately 8 lb. when 250 gal. are forced through it. This pump should be operated automatically with an automatic motor starter and float switch for an open tank, approximately 1,200 feet distant from the pump.

The two Duplex steam pumps now installed we are advised are seldom operated simultaneously and then to supply 134 Imp. gal. per minute, and pump 80,000 to 100,000 gallons per 24 hours. The maximum rating of each, however, is 250

Imperial gal. per minute, so that it might be advisable to keep one of these steam pumps connected as an auxiliary.

For power purposes we recommend a 2200 volt motor driving a 750 Imp. gal. per minute turbine pump against a total dynamic head of 280 feet, including a maximum suction lift of 11 feet, through 2 ft. 10 in. elbows, and advise placing the automatic starter for the fire pump in the sub-station up at the main buildings.

We could make our pump specifications cover all valves and fittings.

To provide lights for the theatre hall, as well as along the Lake Shore road, we advise placing a 10 kw. transformer near the west entrance gate.

For lighting the grounds, we recommend an underground system in three sections, using 35 single light posts about 8 ft. high, and armoured cable.

Brockville Asylum.

We were advised on May 30th, 1911, by the Department of Public Works, that an appropriation of \$2,000 had been made for the installation of electrical wiring and lamps at the Hospital for the Insane at Brockville and were asked to send an engineer to investigate and advise the Department with regard to this work.

An engineer was sent to Brockville in July to look over the lay-out at the Asylum and the following report submitted to the Department of Public Works on September 9th:—

REPORT ON BROCKVILLE ASYLUM.

Acting in accordance with instructions we have made a careful investigation of the requirements at the Brockville Asylum, and as a result recommend that the present appropriation of \$2,000 be expended for lighting the grounds and wiring the rink. We believe that this was the purpose for which the appropriation was made and under the existing conditions is most needed, since at the present time the grounds are not lighted and the rink is insufficiently lighted by gas.

The main buildings are now illuminated by gas and the expense of changing from this to a system of electric lighting would be so great that your appropriation is hardly sufficient to begin the work, which should be left for a subsequent appropriation, and should you desire it we will submit an estimate on the cost of properly wiring all buildings, together with an estimate on the cost of the motors and other electrical equipment which we would recommend.

The main item in a system for lighting the ground would be the selection of a satisfactory light standard. We suggest the use of design No. 37900, shown in the attached catalogue of the Morris Iron Company. Twenty-five of these standards or others similar to this type would be required, together with the necessary underground wiring material. We have estimated that the total cost of this work would be \$1710, not including labor, as this underground work would largely be done by the local rough labor.

The cost of a lighting installation at the rink, in conduit, we have estimated at \$145.00, not including labor.

As an alternative to this recommendation, we have prepared an estimate on the cost of wiring the Executive portion of the main building in concealed iron conduit, the cost including the lighting fixtures. This would give a good start in the work of wiring the buildings, and could be continued through the remainder of the main building and the other buildings in subsequent years as the appropriations are made. We have estimated that the cost of the material for this work would be

\$525.0. The fixtures should cost about \$500; this, however, depends upon the choice of fixtures made. For labor \$875.00 is allowed on account of the high labor cost of installing concealed conduit work in a completed building. It was our intention to have all conduit in the main building and cottages concealed where the pipe comes down the wall to the switches and to cut chases in the masonry deep enough to lay the conduit pipe in and plaster over it; between the floor and the ceiling the conduit was to be laid in a notch cut in the joists, this will require pulling up the floors in order to lay the conduit. This is a very expensive method; but it makes a much better looking installation than exposed conduit anchored to the walls by expansion bolts.

It was finally decided to spend the \$2,000 in wiring the main building in exposed conduit, the wiring lay-out was made for same on white print and forwarded to the Department of Public Works, with a list of the material, for their approval.

The estimated cost of this material was \$2,075.00. The specifications and wiring scheme for this building was approved by E. R. Rogers, Inspector of Asylums, on October 23rd, 1911, and we were asked to obtain tenders on the material.

The specifications, form of tender and instructions to bidders were forwarded to the following on October 24th:—

Northern Electric & Manufacturing Co., Toronto.

The Canadian General Electric Company, Toronto.

The Central Electric and School Supply Co., Toronto.

A. W. John Manville Company, Toronto.

The Raymond Manufacturing Co., Toronto.

The Electrical Fittings Co., Ltd., Toronto.

The John Forman Company, Montreal.

The Eugene Phillips Electrical Company, Montreal.

The tenders received for this material were forwarded to the Department of Public Works on October 31st, without recommendations.

Penetanguishene Asylum.

We received a letter on Aug. 3rd, 1911, from Mr. Edwin R. Rogers, Inspector of Asylums, requesting that one of our engineers examine the plant for the Hospital for the Insane at Penetang, and submit a report showing the requirements at this Institution to enable them to purchase power from the Town.

We advised Mr. Rogers on August 19th that a report giving the estimated cost of changes was being prepared, and called attention to the size of the motor required for the chopper, laundry, carpenter shop, bakery and machine shop. We also advised the installation of a pump which could be connected to the present standpipe, and also of fire hydrants, and additional surface mains for watering the lawns, the present city mains to be used for supplying the drinking water only.

We further recommended new outside lamps for the courts and driveways, the installation of all wiring in iron conduit except that in the doctor's residence, and that the present generator and the switchboard be moved up to the main building power house, and a new panel with throw-over switches installed.

A report was forwarded to the Department of Public Works giving an estimate to cover the cost of electrical apparatus, wiring buildings in iron conduit, lighting

grounds, and motor driven turbine pumps which would be required at the Hospital in September, as follows:—

<i>Item.</i>	<i>Capital Cost.</i>
One turbine pump and motor	\$1,250 00
Electric Irons	66 00
Service Transformers	425 00
Motors ..	735 00
Switching Apparatus	1,000 00
Moving Engine and Dynamo	150 00
Lighting Grounds	1,107 00
Wiring Buildings in Iron Conduit	2,500 00
	<hr/>
	\$7,233 00
Engineering and Contingencies, 10%	723 00
Interest during Construction, 1½%	108 00
	<hr/>
Capital Cost	\$8,064 00

The estimate for pump covers one 300 Imp. gallon pump for a working pressure of 90 pounds.

The allowance for electric irons covers 1—5 lb. iron, and 2—7 lb. irons.

The estimate for motors covers:—

One 12 h.p. for use at Stables.
 One 10 h.p. for use in Laundry.
 One 5 h.p. for use in Carpenter Shop.
 One 5 h.p. for use in Bakery.
 One 5 h.p. for use in Machine Shop.

The estimate for switching covers the remodelling of present lighting panel and the cost of two new panels with necessary oil switches, knife switches, meters, etc.

The estimate for inside wiring in iron conduit covers the material for main building. Some of the old material removed from this building will be used to wire or repair buildings that are at present wired with cleat or knob work.

The laundry wiring should be repaired, new wires run to electric irons in conduit, and new panel box installed. We also suggest placing new service boxes in the hog, cow and horse buildings, and wiring them in iron conduit.

The ground lighting estimate covers painted wooden poles, four foot iron brackets with 50 standard multiple street-hood reflectors and 100 watt tungsten lamps.

MUNICIPAL RATES.

As stated in the last report, several meetings were called and attended by representatives of the various municipalities for the purpose of discussing, and eventually standardizing, the rates for which energy was to be sold. The recommendations of the Committee appointed to investigate this subject are given in the Minutes of the Municipal Engineers' Meeting appearing in another part of this report. A member of the Engineering Department was appointed secretary of this Committee, and a standard system of rates was adopted by the majority of the municipalities.

The schedule employed for light and power in the various municipalities is given on the following pages. It will be noted that a local discount is included so that these base rates may be made applicable to all of the municipalities, regardless of their power costs, by varying the local discount. The municipalities using this schedule are given in the following list, with the local discount which each have adopted:—

Municipality.	Discount from Base Rates.	Residence Lighting.		Commercial Lighting.		
		Per C. Sq. ft.	Per Kw-hr.	1st hr. per Kw-hr.	Per Kw-hr. additional.	
	%	cents	cents	cents	cents	
Hamilton	25	4	3½	10	3½	Commercial flat rate, \$6.00 per kw. month.
Dundas	33 1-3	4	3½	10	3½	
Hespeler	None.	5 10 plus 15c. meter rate.	5	14	5	Flat Commercial rate, \$7.00 per kw. month.
Preston	10	4	4½	12	4½	Commercial flat rate, \$6.00 per kw. month.
Galt	10	4	4½	12	4½	Commercial flat rate, \$6.00 per kw. month.
Berlin	10	3.5 (Minimum bill per month, \$1.00).	3.6	12	5	
Waterloo	None.	.....	.....	.....	.....	Commercial flat rate, \$6.00 per kw. month.
New Hamburg	None.	.....	.....	.....	.....
Stratford	None.	4	4½	12	4½	
St. Mary's	None.	.....	.....	.....	.....	Commercial flat rate, \$6.00 per kw. month.
London	10	.....	5	.....	5	
St. Thomas	None.	3	5	12	5	
Ingersoll	None.	.....	10	.....	10	Sign lighting, 6c. kw.-hr.; heating, 5c. kw.-hr.
Woodstock	10	3	4½	12	4½	Commercial flat rate, \$6.00 per kw. month.

After these schedules had been adopted and placed in service by the different municipalities a discussion arose relative to the form of the schedule and a number of changes were suggested, especially in the power schedule. The Toronto Hydro-Electric Commission suggested a different form of service and consumption charge. This was approved and variations of it have been adopted by other municipalities. The latter schedule is as follows:—

Municipality.	Flat Rate Power.		Differential Rate Power.						Residence Lighting.		Commercial Lighting.	
	1st 10 h.p. per h.p.	All additional, per h.p.	1st 10 h.p. per h.p.	All additional, per h.p.	1st 50 hr. per kw-hr.	2nd 50 hr. per kw-hr.	All additional, per kw-hr.		Per 100 square ft.	Per kw-hr.	1st hr. per kw-hr.	All additional, per kw-hr.
Toronto.....	.....	.....	1.35	1.00	c. 1½	c. 1	c. ½		c. 4	c. 3	c. 8	c. 3
Brampton.....	45.00	39.00	1.35	1.00	3	2	1		4	5	12	4
Tillsonburg.....	50.00	40.00	1.35	1.00	3	2	1		4	5	12	5
Midland	40.20	32.64	1.35	1.00	2½	1½	¾		4	4	12	4
Penetang	40.20	32.64	1.35	1.00	2½	1½	¾		4	4	12	4
Seaforth.....	56.00	46.75	1.35	1.00	4	2½	1½		4	6	12	6
Weston .....	.....	.....	1.35	1.00	2½	1½	¾		4	4	12	4
Mimico	51.00	39.00	1.35	1.00	3	2	1		4	4½	12	4½
Waterdown	51.00	39.00	1.35	1.00	3	2	1		4	4½	12	4½
Port Arthur.....	42.00	30.00	1.35	1.00	2	1½	¾		4	3½	8	3½

APPLICATION FOR ELECTRIC LIGHTING SERVICE.

To the Municipality of Dundas, Ont. :

Subject to the conditions and rates printed on the back of this application, the undersigned, hereinafter called the Consumer, requests the Corporation of the Municipality of Dundas, hereinafter called the Corporation, to make the necessary service connections and furnish electrical energy at the premises, No..... within the Municipality, owned by..... and occupied by the Consumer, as a..... for..... lamps, or their equivalent.

The Consumer agrees to take from the Corporation all the electrical energy required by him for lighting purposes for the term of years, commencing and to pay monthly for said electrical energy in accordance with the base rates of the Corporation as printed on the back hereof, subject to a local discount of not less than per cent., under Class..... under which the Consumer's service is to be rated, and subject to a further cash discount of 10 per cent., provided Consumer makes payment of account at the Corporation's office within ten days from date of the bill.

The Consumer agrees to pay a minimum amount of dollars per month. The Corporation agrees to renew only exhausted standard plain incandescent carbon filament lamps with Edison base of 8, 16 and 32 c.p. free of cost to consumer, provided same were originally purchased from the Corporation.

Signed..... Consumer.
..... Contract Agent.
Consumer's Business Address.....
Approved and Accepted for the Corporation.
Date.....

CONDITIONS.

1. The Consumer agrees to provide convenient and safe space for the Corporation's meters (for which no rental charges will be made), wires and all other appliances in said premises, and further agrees that no one who is not an agent of the Corporation or otherwise lawfully entitled to do so, shall be permitted to remove, inspect or tamper with the same, and that the properly authorized agents of the Corporation shall, at all reasonable hours, have free access to the said premises for the purpose of reading, examining, repairing or removing its said meters, wires and other material and appliances.

2. Meters and all other appliances of the Corporation in said premises shall be in the care and in the risk of the Consumer, and if destroyed or damaged by fire, or any cause whatsoever other than ordinary wear and tear, the Consumer shall pay to the Corporation the value of such meters and appliances, or the cost of repairing or replacing the same.

3. The Consumer hereby expressly authorizes and empowers the Corporation at its option to remove the meters and all other material and appliances installed at its expense and cut off the supply of electricity and terminate this agreement whenever any bills for said service are in arrears or upon violation by the Consumer of any of the terms and conditions of this agreement.

4. The Corporation agrees to use reasonable diligence in providing a regular and uninterrupted supply of electricity, but does not guarantee a constant supply of electricity, and will not be liable in damages to the Consumer for failure to supply electricity to said premises.

5. This agreement shall not be binding upon the Corporation until accepted by it through its proper officer and shall not be modified, or affected by any promise, agreement or representation by any agent or employee of the Corporation unless incorporated in writing into this agreement before such acceptance.

6. The Consumer agrees that on request of Corporation he will deposit with the Corporation the sum of dollars, to be held by Corporation as a guarantee that Consumer will fulfil all the terms of this agreement.

7. The Consumer will provide all lines on the premises and all lines connecting premises with the point of delivery, and maintain the same in efficient condition with proper devices, the whole according to the requirements of the Canadian Fire Underwriters' Association.

8. This agreement shall continue in force after the term herein mentioned from year to year until terminated by a notice in writing, given by either party hereto at least one month before the end of the term or any yearly term thereafter.

9. It is agreed that the signatures of the parties hereto shall be binding upon their successors or assigns and that the vacating of the premises herein named shall not release the Consumer from this agreement, except at the option and by written consent of the Corporation.

TITLE AND FYLING DATA

No. Form.

LIGHTING CONTRACT

BETWEEN

THE MUNICIPAL CORPORATION OF
DUNDAS, ONTARIO,
AND

Name

Address

Succeeding

OWNER OF PREMISES.

Work Order No.

Date Connected

Date Disconnected

No. of Lights

Total Connected Wattage

Kind of Current

Class and Rate of Service

Contract Noted by

" "

" "

Remarks:

BASE RATES FOR LIGHTING.

Residence Lighting:—
Fixed charge per 100 square feet of area lighted, 4 cents per month.
Additional charge per K. W. H. as metered, 3½ cents.
Note re Measurements:—
To determine the area lighted, the maximum outside dimensions of the building are to be taken, and the product multiplied by number of residence floors, and the total amount reduced by 10 per cent. for walls, etc. Basement and attic not to be included, unless in whole, or in part, used as living or sleeping rooms.
CLASS 2
Commercial Lighting:—
(a) Stores and Theatres:—10 cents per K. W. H. for first hour's daily use of installed capacity, and 3½ cents for each K. W. H. above.
(b) Signs and Display Lighting:—Same, or flat rate option.
(c) Churches:—One-half above rates.
(d) Factories:—Same, if they are not using power. If they are, the transformer capacity required for connected lighting load may be added to the motor load, and charged at power rates.
(e) Hotels:—Same as stores. Peak load may be controlled.
CLASS 3
Flat Rates:—
For sign, window, and display lighting, \$6.00 per month per K. W. connected.
A 16 Candle Power Carbon Lamp equals, approximately, 55 Watts; 1,000 Watts equals one Kilo Watt.

Continuing our investigation of rates, letters were sent to all of the large Hydro-Electric Generation and Distribution Companies of the Dominion and the United States asking for their lighting and power schedules, and on receipt of these a report was made up from which we shall quote as follows:—

“In reply to our circular letter, dated September 27th last, which was sent to various municipalities and electric supply companies throughout Canada and the United States, forty-four letters have been received. Seven of these state that for some reason or other, the information asked for cannot be given, two state that it will be forwarded in a few days (in neither case has the information been received at this office up to date) while the remaining thirty-five give in more or less detail, the system of charging in vogue.

“Owing to the extremely diverse nature of these systems, to classify them under every possible heading would be a very laborious and somewhat unprofitable task. The main points only are therefore considered in this report and the following classification appears to be the most useful:—

“The first division is, naturally, charges for lighting and those for power. For each of these the following systems are employed:—

1. Flat Rates—fixed or varying with quantity.
2. Meter Rates—fixed or varying with quantity.

Meter Rates are sub-divided into—

1. Simple Rates, that is, a fixed charge per kw-hr. only, with or without either or both of the following:—

- (a) Minimum charge, fixed or varying.
- (b) Discounts, fixed or varying.

2. Compound Rates, that is, a fixed or variable charge per kw-hr. with or without any or all of the following:—

- (a) Minimum charge, fixed or varying.
- (b) Discounts, fixed or varying.
- (c) Service charge, fixed or varying.

Prompt payment discounts and meter rentals are not considered here as these do not affect the question of rates.

Attached to this report is a detailed statement of the various systems of charging used by each of the undertakings in question and a tabular statement giving the numbers of those whose systems come under the different heads. The numbers in brackets are totals, while the others refer to those given opposite the individual undertakings in the detailed statement. Another sheet gives the outstanding features of the tabular statement in the form of diagram.

A study of the foregoing shows that:—

A. *Lighting.*

(a) Meter rates are more than twice as popular as flat rates, and the latter are, generally speaking, used only for small consumers.

(b) Compound meter rates are slightly more numerous than simple meter rates.

(c) Service charges and sliding discounts, while equal to each other, are far outnumbered by minimum charges.

B. *Power.*

(d) Same as “a” above.

(e) Compound meter rates are used by all the undertakings which have meter rates for power, but simple meter rates only by three of them.

- (f) Minimum charges are more in evidence than service charges.
- (g) Sliding discounts are employed only in two instances.
- (h) Restricted-hour service is provided by five different concerns and restricted-season service by only two.

C. Lighting and Power.

In one instance flat rates for lighting are being discarded, and in another case they have been adopted for power in preference to meter rates.

Some of the undertakings are small and have no rates for power, while others are large and have no rates for lighting.

Some differentiate their charges for sign lighting, heating and cooking, etc., and others do not.

One gives less discount in summer than in winter.

Looking over these different rates and judging from the character of the companies using the rates, we believe that the companies as a whole are working toward a system of charge consisting of a monthly service charge plus a charge per unit of consumption. We also received confidential letters from some of the companies, acknowledging that the rates in use were not acceptable to their engineers, but, through local commercial conditions, were compulsory on them and that they hoped to modify them. Confirming this belief of ours we would point to the reports of the various Electrical Associations who have made investigations and reports on the same subject. We would especially refer to the report of the National Electric Light Association for the year 1911. All these facts emphasize our belief in the justice of the combined rate which we are trying to place in an acceptable form."

MUNICIPAL PURCHASES.

An important branch of the work done by the Commission is the purchase of material and apparatus for the maintenance and operation of transmission and distributing lines and sub-stations, the equipment for extensions, and the apparatus and material required by Municipal Electrical Departments of the Province and many of the Provincial Institutions.

The system and the municipalities require yearly, material and apparatus in considerable quantity and great variety. The detailed work involved in the execution of orders necessitates a complex routine which can be more readily attended to by a special staff, and with the rapid growth of the system it was considered advisable during the close of 1910 to organize a Purchasing Department. One section of this Department attends to the requirements of the transmission system, while another section devotes its entire time to the execution of orders for the Municipalities. It has been the endeavor of the Department to act as a general buying agent, and by considering the total requirements of the system and the municipalities obtain costs much lower than those obtainable by independent purchases of smaller quantities. Being centrally located the Purchasing Department can obtain information quickly, and through the facilities at its command can criticise quotations and the various supplies and apparatus; it is thus in a better position to make recommendations upon quality and price than an independent purchaser in a locality more remote from a large buying centre. Also, being in close touch with the various manufacturers the Purchasing Department can give careful attention to the execution of the orders and see that shipments are made as promised.

There are now twenty-five Municipal Electrical Departments purchasing through the Commission, and with the increased quantities which may be expected with the extension of this central buying idea the department will be in a position to obtain still better prices, and by entering into contracts it will be possible to improve shipments. Among the important services already rendered to the Municipalities may be mentioned the saving effected in the building of their "distribution" lines. The extent and value of the more important items purchased through the Commission during 1911 are indicated in the summary included at the end of this report. The quantities shown will serve to emphasize the importance of buying for the system as a whole, in large quantities, at considerably reduced prices.

The advantages of co-operation of this kind are specially marked in the case of Incandescent Lamps. Information already at hand shows that by contracting for yearly requirements in large quantities a saving in some cases of 25 per cent. can be effected. Comparative tests designed to show the merits of the various domestic and foreign carbon and tungsten lamps are now being conducted, and upon their conclusion specifications will be prepared and the Commission will be in a position to obtain for municipalities reliable lamps of a definite standard of quality and price.

Similar tests are also being carried out with the various domestic and foreign Wattmeters of the Lighting Service Type, and upon the conclusion of these tests specifications will be prepared and these Wattmeters will be standardized.

At the present time, there exists in the Province a general lack of electrical standards. This condition has been appreciated by the Commission's Engineers, who have prepared a number of specifications which are available for those re-

quiring such standards, and in due course complete specifications will be available for all of the various apparatus and supplies which can be standardized.

The general work of the Commission's Engineering and Purchasing Staffs has covered a field ranging from the purchase and installation of the largest electrical and hydraulic apparatus required for the equipment of the power and lighting plants in the various sub-stations and municipalities down to the minor supply items. With all the facilities of a complete organization at its command the Commission is in a position to give expert engineering advice, and takes this opportunity of offering the services of its Engineering and Purchasing Staffs to any of the Municipal Electrical enterprises in the Province.

A summary of the more important purchases made by the municipalities through the Commission during the year 1911, is approximately, as follows; a sum total of each of the various segregated classes of apparatus being made:—

Line material, Cross Arms, Braces, etc.	Poles of various sizes.		Motor driven Apparatus and Motors.	Incandescent Lamps.	Wattmeters.		Transformers.		Panels and Switch Gear.	General Supplies, etc.
	Number.	Cost.			Number.	Cost.	Total kw.	Cost.		
\$61,757	1,723	\$4,744	43 h.p., \$770	\$23,164	463	\$5,101	2,443	\$24,790	\$16,979	\$32,112
.....	.....	.....	\$7,319	.....	.....	\$10,440	.....	\$47,966	.....	.....

Grand total, \$235,142.

MUNICIPAL ENGINEERS' MEETINGS.

Fourth Meeting.

The Fourth Meeting of the Municipal Engineers was held in Toronto on November 16th and 17th, 1909, and called to order with the following Municipalities represented:—London, Preston, Berlin, Woodstock, St. Mary's, Waterloo, St. Thomas, Guelph, Hespeler, Toronto, Galt, Stratford.

Street Lighting.

The following Report was submitted by the Committee on Street Lighting:—

"Your Committee have visited a number of typical street lighting installations in the States of Massachusetts and Ohio and our observations and conclusions may be briefly summed up as follows:—

In the arc lighting field the so-called magnetite or Metallic Flame arc lamps are rapidly superseding the enclosed and other forms of arc lighting. The standard lamps of these types are of 4 amperes capacity and are operated from A.C. circuits of any frequency by means of C.C. transformers and Mercury arc rectifiers. The distribution of light from this lamp is ideal for street lighting, giving as it does its maximum candle power at about 10° below the horizontal. The tube life is showing marked improvement over early records and may be safely estimated on as from 1,000 to 1,200 hours, individual large installations being found having tube life averaging over 1,600 hours.

The maintenance cost of this system is found to work out as follows:—

Electrodes.....	20 to 22 trims.....	\$1.50 to \$1.65
Tubes.....	50 light circuit.....	1.90 to 2.40
Labor.....		1.30 to 2.50
Glassware.....		.50 to .75
		<hr/>
		\$5.40 \$7.30

Well constructed and insulated circuits are found to be conducive to length of tube life.

In Toledo, with 2,400 lamps, records of outages only show 2/10 of one per cent.

These lamps give good results even when spaced as far apart as 300 to 400 feet.

In Boston they are using a 6.6 ampere magnetite which is about $2\frac{1}{3}$ times as powerful as the regular 4 ampere lamp. This is a very powerful lamp, but the hours of burning are only about 70 to 80 hours. As yet nothing is known concerning the 6.6 ampere rectifier tube.

Flame lamps are also used with good effect for square lighting, etc., but their high trimming costs make them very expensive.

Low operating costs combined with relatively high efficiency make the 4 ampere luminous arc lamp the favorite for all open streets where relatively high illumination is desired.

We found series tungsten street lighting very prevalent in the smaller cities and towns of New England. They are, in the great majority of cases, operated from C.C. Transformers. A lamp life including accidental and malicious breakage of from 2,000 to 2,500 hours is reported in all cases. The fire-enamelled radial wave reflector is being widely used because of its durability and high efficiency. It is the general opinion that the long life of the series tungsten is partially attributable to the good regulation of the C.C. Transformers.

In certain cases where underground distribution was required, we found multiple tungstens being used with good results and reported long burning life. The low voltage multiple system seeming to lend itself to low installation costs. 250 watt tungsten lamps in multiple in opaque balls on ornamental iron posts are used in a business street of a New England City with good effect.

Your Committee would recommend the use of the 4 ampere luminous arc lamps for cases of open or business streets where a medium to high illumination is desired, and the series tungsten system for residential and heavily treed districts where a lower average illumination is desired."

General discussion followed and recommendations were made by the street lighting experts from the Westinghouse and General Electric Company.

13,200 Volt Insulators.

The standard insulator formally chosen, known as Type No. 10,044, has been tested and found too small for the voltage while the new type No. 2041 was found superior under test. At the recommendation of the Engineering Department the latter type accepted as a standard was approved and the Commission was asked to secure data and prices on the longer pin.

Municipal Control of House Wiring.

The resolution passed at the previous meeting relative to house wiring had been referred and approved by the Commission. It was suggested that a draft of the by-laws, which were to be prepared by the Engineering Department, be sent to the various engineers for consideration and suggestions.

Prices on Cross Arms.

The Engineering Department submitted prices on long leaf yellow pine and native wood cross-arms.

Transformer Specifications.

The Committee appointed to prepare standard step-down Transformer Specifications, submitted a progress report.

Regulation.

Since the transformers in all stations must be interchangeable it is necessary that the regulation as secured be uniform for any given sizes, even though the transformers be manufactured by different concerns. Moreover the regulation should be the same for all transformers at varying power factor.

It was found impossible to designate any limits for this regulation and it was, therefore, decided to write the various manufacturers to ascertain the minimum limit and also the variation that might be expected in the regulation of transformers of similar design commonly manufactured. After discussion, it was agreed that both the resistance method and thermometer should be used in the measurements of temperatures and, with shell type transformers, since hot spots are likely to develop within the core which neither method can discover, it is recommended that design drawings be carefully examined to ascertain whether or not cooling oil can circulate freely to all parts.

Potential and Insulation Tests.

It was considered advisable to subject all transformers to the following tests to determine insulation characteristics:—

1. Measurement of insulation resistance, cold.
2. A second measurement of insulation resistance at the termination of the temperature test.
3. High voltage test $2\frac{1}{2}$ times normal applied for one minute between windings of core and case.
4. Operation at double voltage for a period of five minutes.
5. Final measurement of insulation resistance while the transformer is still hot.

This latter measurement should be a relative indication as to whether or not the transformer has been damaged in any way through the high potential tests.

Other points were discussed among which the following are the most important:—

Manufacturers to state kind of oil to be used, and characteristics of the same. Oil must not become deposited and clog the circulating ducts.

Thermometers are advisable for all station and railway transformers, but the design must be such that breakage of thermometers will not permit the oil to leak from the case.

Coils to be thoroughly braced to withstand short circuits.

A specification to be prepared to include single-phase and three-phase types, also water cooled, self cooled and air cooled styles under both types, the object being to cover as many designs of different manufacturers as possible. In this connection comes the question of standard ratings, and it is advisable that a few given sizes be chosen for single-phase types together with equivalent three-phase sizes which the manufacturers shall agree to furnish as standard and in such quantities as may be required.

Considerable discussion ensued and it was finally decided that the oil known as "Mineral Seal" was to be specified; and a test for dryness should be inserted, and that thermometers "are advisable for all station and sub-way transformers."

Comparison—Single and Three Phase Transformers.

The Engineering Department of the Commission submitted comparative prices, weights and sizes for single and three-phase transformers. The data are as follows:—the figures being merely comparative and approximate.

Prices.				Weight.		Dimensions.			
3	10 kw.	sgl. ph.,	..	\$750	\$825	3,090	4,200	29 by 21½ by 35	38 by 24 by 59
1	30 "	3 "	..	700	610	4,320	4,200	54 " 27½ " 70	47 " .. " 70
3	25 "	sgl. "	..	1,095	1,380	6,384	6,600	37½ " 23 " 41	45 " 37 " 78
1	75 "	3 "	..	950	1,015	4,700	6,650	54 " 27½ " 70	55 " .. " 66
3	50 "	sgl. "	..	1,950	2,100	7,350	7,890	34½ " 24 " 63	39 " 30 " 48
1	150 "	3 "	..	1,550	1,540	10,000	6,975	57½ " 29½ " 76	65 " .. " 72
3	100 "	sgl. "	..	2,250	3,555	18,000	14,490	46 " 31 " 82	49 " 38 " 55
1	300 "	3 "	..	1,800	2,610	16,000	12,600	80½ " 40 " 101	65 " .. " 96
3	200 "	sgl. "	..	3,675	5,100	21,690	21,900	53 " 35 " 91	60 " 46 " 60
1	600 "	3 "	..	3,000	3,740	20,900	19,820	87½ " 44 " 127	79 " .. " 120

Note.—Prices and data were received from several companies and the high and low are given in each case in the table above.

Rates for Incandescent Lighting.

The subject of the rates which should be charged for incandescent lighting was discussed at length. The comparative costs for house lighting for various consumers in Berlin was presented, and showed that the method proposed at a previous meeting was fair and equitable, and that it reduced the monthly bill of a person who required considerable light in proportion to the size of his house, affects slightly the average user, and increases the monthly bill of those persons employing little light in relation to the size of their houses. Such being the case the rate per foot of floor area and the rate per kw-hr. can be modified to suit the requirements of any municipality.

Data were also presented showing the effect of the method of charging, proposed by the City of Toronto, on the monthly and annual bill of various classes of customers. It was found that this plan did not tend to increase and popularize the use of electricity in residences.

Various changes were suggested and the following resolutions finally adopted:—

“Resolved that the consensus of opinion is that the method of charge for house lighting shall be a differential rate consisting of a charge a square (100 square feet) of the floor area of the building figured from the outside dimensions, not including cellars and attics, except when used for living rooms, as a fixed monthly charge, and in addition thereto a fixed meter rate as low as the local conditions shall warrant.”

“Resolved that it be the recommendation of this meeting that a 10 per cent. discount for prompt payment be used when determining the monthly bill and the discount be allowed on the total bill, on the fixed charge as well as on the charge per kw-hr.”

Energy Rates.

This subject having been generally discussed it was resolved that the considerations and decisions in the matter should be pushed, and in order to accomplish this, a Committee was appointed to make a report and mail a copy to each engineer for consideration before the next meeting.

Fifth Meeting.

The Fifth Meeting of the Municipal Engineers was held in London on December 14th and 15th, 1909, and called to order with the following municipalities represented :—London, Berlin, Woodstock, Waterloo, St. Thomas, Guelph, Stratford, Galt.

The following report was submitted to the Committee on energy rates:—

Report of the Committee on Energy Rates.

“We assumed at first that the case under consideration was that of a city where power from the power circuits must be sold at \$50 to cover power costs plus costs of distribution, labor, administration, etc., in fact all the costs properly chargeable to this service. This figure was assumed as it would show more clearly the proportions between the various kinds of service, and all other proposed prices are figured on the same basis.

We concluded that the proportions between the costs of the various kinds of service could be fixed for all municipalities and these proportions are as follows:—

Flat Rate.

Give a flat rate of \$50.00 a h.p. a year on a consumer’s total motor rating with unlimited hours of service, the total motor rating being the sum of the full load capacity of all motors used. Or giving a corresponding rate of \$45.00 for 10 hour power (the common use of power from 7 a.m. to 12 noon and 1 to 6 p.m.) or giving a corresponding rate of \$33.50 for restricted hour service, (these hours being made to correspond with sun-time in each municipality).

The proportions between the prices were determined as 100 per cent. for the first-class, 90 per cent. for the second, and 66 2-3 for the restricted service.

Any customer who will furnish and maintain a satisfactory curve-drawing meter can secure these same rates paying on the monthly maximum demand, using the momentary maximum shown on the curve (where obviously not a short circuit) as the power to be paid for. The monthly bill shall never be less than the maximum previously recorded unless some change is made which reduces the number or capacity of the motors in service, a written notice of such a change with a request for a new limit being filed previous to the beginning of the month when such a reduction in capacity will be allowed. (If the maximum monthly bill of say 75 per cent. of the previously recorded maximum should be used, it would necessitate increasing the rates over the flat rate per h.p. connected up in order to make the plan equitable.)

Differential Rates.

A consumer having a load factor too low to warrant the flat rate method of charge shall be given the Differential Method of charge, the rates being the following:—

Total h.p. in motors in service.	Monthly fixed charge per h.p. of motors in service.	Rate per kw. used per month, read by meter.
1-3	\$1.50	4c.
Above 3 and including 6	1.45	3¾c.
“ 6 “ “ 15	1.40	3½c.
“ 15 “ “ 30	1.35	3c.
“ 30 “ “ 55	1.30	2¾c.
“ 55 “ “ 100	1.25	2c.
“ 100	1.20	1½c.

These prices are based on the \$50.00 a h.p. on motor rating basis, and are subject to the same proportionate reduction as is made in this rate per h.p. to adapt it to the conditions in each municipality. That is if a town sells 24 hour power at \$35.00 (70 per cent. of \$55.00) the fixed charge under this method, of a consumer with 50 h.p. in service, would be 91c. a h.p. a month and a rate of 13¼c. a kw-hr.

Discount.

After all rates are determined, they should be increased by one-ninth to allow for 10 per cent. discount for prompt payment."

There was a general and prolonged discussion on the suggestions of the Committee, during which it was carefully explained that the prices suggested were not to be adopted by each municipality as prices, but instead were used to show the proposed ratios between the various types of service, and if the price of 24 hour flat-rate power at \$50.00 is reduced in any municipality by (as an example) 25 per cent. all the other prices would be reduced in the same proportion. The Committee would not determine general rates for all the municipalities, but the method of making rates by the various municipalities could be investigated and recommendations made.

Report of Transformer Committee.

This report recommended that no close standard should be adopted, since it would tend to restrict developments and improvements; that each municipality secure transformers best suited for their use, bearing in mind the previous recommendations of the Engineering Meetings regarding voltage, taps, etc.

Report of Committee of Municipal Auditors.

The Chairman of this Committee reported that progress had been delayed by difficulties encountered in financing their expenses.

The following motion was moved, seconded, and carried:—

"Whereas it was necessary for the Hydro-Electric Power Commission in settling rates and disputes to have a uniform system of accounting, be it resolved that such a system should be devised, and that it be the opinion of this meeting that the Commission assume the burden of devising such a system either by using the system planned by this Commission or by formulating a system independently; and further be it resolved that a request for prompt action be made, as the construction accounts covering the present municipal work should be sub-divided in accordance with the system adopted."

Report of the Committee on Power Rates.

This report recommends the revision of previous suggestions somewhat as follows:—

It was decided that the small users of power should not be given the same rate per h.p. under the Flat Rate method of charge as can be given the large users, since the cost of serving the small user is greater in proportion than the cost of serving the large users. Therefore, the flat rate per h.p. has been modified.

Amount of Energy Taken in H.P.	Cost per H.P. per Year.
1-3	\$50.00
Above 3 and including 10	48.00
" 10 " " 25	45.00
" 25 " " 50	43.00
" 50 " " 100	41.00
" 100	40.00

The 20 hour power users (those who use power all 24 hours, except during the lighting load, 12 months during the year) will be given a rate equal to 90 per cent. of the above.

The 10 hour power users (those who use power up to and during the lighting peak) will be given a rate equal to 90 per cent. of the above.

The 10 hour restricted-service power users (those who use power only up to the beginning of the lighting peak) will be given a rate equal to 66 2-3 per cent. of the above.

The Differential Rates have been devised so that the rates will change at the same point as the rates under the flat rate system; they have been changed so that the meter rate is a charge a h.p. instead of kw-hr., they have been increased so as to be subject to the same discounts (90 per cent. and 66 2-3 per cent.) on the flat rates for the various classes of service; and they have been modified so that a consumer with a load factor of 50 per cent., working 3,000 hours a year, would have practically the same bill under either method of charge. The suggested proportions are as follows:—

Amount of H.P. Connected Up.	Monthly Charge a H.P.	Meter Rate a H.P.
1 to 3		c.
Above 3 " 10	\$1.25	3½
" 10 " 25	1.20	3
" 25 " 50	1.15	2½
" 50 " 100	1.10	2
" 100	1.05	1½
	1.00	1¼

This report was accepted provisionally to be considered and thought over by all until next meeting, when it will be brought up for final discussion.

Transformers with 2,200 Volt Low Tension Windings.

Recommendations were made and approved that transformers with 2,200 volt low tension winding should have four coil secondaries, so that they may be used for 550 volt circuits if desired.

Committee on Commercial Lighting.

A committee was appointed to prepare a method of charge for commercial lighting.

Sixth Meeting.

The Sixth Meeting of the Municipal Engineers was held in St. Thomas, on January 11th and 12th, 1910, and called to order with the following municipalities represented:—St. Thomas, London, Preston, Guelph, Woodstock, St. Mary's, Waterloo, Berlin.

Power Rates.

The Committee on power rates suggested changes in the plan proposed and accepted provisionally at the previous meeting. These recommendations were approved.

Based on the resolutions as to power rates adopted provisionally at the meeting of December 15th, 1909, and as an extension of the discussion thereof, the following memorandum applies:—

Assumptions.

1st—Assume same base rate as per resolution of December 15th.

2nd—Reduce all rates herein to yearly basis and make all quotations in dollars, instead of by discounts from the base rates.

3rd—All discounts from the base rates are decided by each separate municipality, to suit its needs.

4th—All discounts for cash to be fixed by the united municipalities at say 10 per cent. by way of illustration.

On this basis the following tables and remarks apply:—

In table No. 1, the first line is that of the provisional resolution referred to. The second is that suggested for consideration.

The classes of customers have been divided into five classes, and each class is discussed separately below:—

Class A.

These are purely arbitrary figures used in an endeavour to obtain a basis to work from. As the whole structure depends upon this base being correct, it should be carefully considered whether these rates are sufficient to cover the costs for power for the smallest motor, in the smallest municipality at the greatest distance, say St. Mary's for instance. In other words, to cover the most unfavorable conditions. If this base be changed, the rest of the discussion herein fails and must be changed accordingly.

Class B.

This is obtained from Class "A" as per resolution, by a discount of 10 per cent. Suggested schedule merely rounds up the odd cents into dollars.

No mention has been made of 20 hour power, and the question is whether it would not be advisable to call this 24 hour *restricted* power as it leaves a wider scope for arrangements to customers and is on the same lines as the 10 hour restricted power below.

Class C.

The suggested rates merely round up the dollars in the rates suggested by the Resolution and are the same as the 24 hour restricted power, as per that Resolution.

Class D.

The same procedure as above determines the suggested rates, a slight advantage being given in the adjustment to the larger units, and a slight disadvantage given to the first group as compared with the Resolution Rates. It is suggested that this is in the interest of fairness and good policy.

Class E.

In this table the rates per month of the resolution are taken as the basis, and from these the differential rates necessary to equate with the 10 hour unrestricted rate are determined, assuming that a 50 per cent. load factor is the equating point. These meter rates are given in line 3 of the table.

After figuring out several schemes, a suggested flat and meter rate of \$12.00 a year and 2c. a kw.-hr. respectively were selected, and in the fifth line the load factors for which these equate with the 10 hour unrestricted rate are given.

It will be noted under this heading:—

1st—That the flat rate is the same for all power, large or small, and should catch all business.

2nd.—Similarly for the suggested meter rate. It will be noted from the load factor that the small user under this rate obtains advantage which the large user does not. This is for the encouragement of the large.

This as submitted is in the interest of the public demand generally and of good business policy on the part of the municipality, as it is not desirable that the large user should be encouraged too much to take the differential rate.

Unrestricted Use.

Under this differential rate it is suggested that unrestricted use be allowed as tending to simplify book-keeping, inspection and detection, and that the rates indicated are high enough to permit of this. Customers using this rate will be small consumers in nearly every case and cannot be checked up as to restricted hours and will be able therefore to have much more satisfactory use without imposing very much on the peak of the load.

Power Factor.

In all of the above rates the question of power factor will enter and must be met in some way. It is suggested in the interests of simplicity that the municipality establish a scale of full load power factors for different classes of motors allowed on the lines, which will ensure the purchase of good machinery by the customer, and then take no account of power factor whatever in billing customer. While it is true in theory that a bad power factor due to small load does impose on the machinery and equipment, yet the difficulties of checking this matter with many customers is a serious one, and as the poor power factor of any customer will only affect the purchase of power by the municipality through the Commission at the peak of the load during the winter time, when the lighting will assist in the general power factor, it becomes questionable whether it is advisable to penalize the customer for poor power factor if their motors are satisfactory. All of this is in the interests of simplicity.

It might be considered advisable on the other hand to reward those who install synchronous motors by a further discount in rates. This is for considera-

tion. This class will form but a small portion and might be considered as specials in dealing with it in the schedule of rates.

With the above suggestions in mind, the attached table No. 2 has been drawn up to illustrate the schedule of rates, which might be printed on the back of the municipal accounts. These rates here indicated are those suggested for each class. It will be noted that spaces for different rates of discount are shown for each class. Consideration should be given to whether the municipality could not, instead of cutting each rate with a separate discount, use an identical discount for all classes, as a matter of fact, Classes C and E must be similarly discounted if their equities are to be maintained.

POWER RATES.

GROSS PRICE PER HORSE POWER PER YEAR—TABLE No. 1.

	1 to 3 h.p.	3 to 10 h.p.	10 to 25 h.p.	25 to 50 h.p.	50 to 100 h.p.	100 h.p. up- wards.
	\$	\$	\$	\$	\$	\$
Class A—						
24 hour unrestricted power	50.00	48.00	45.00	43.00	41.00	40.00
Suggested.....	50.00	48.00	45.00	43.00	41.00	40.00
Class B—						
24 hour restricted power	45.00	43.20	40.50	38.70	36.90	36.00
Suggested.....	45.00	43.00	41.00	39.00	37.00	36.00
Class C—						
10 hour unrestricted power.....	45.00	43.20	40.50	38.70	36.90	36.00
Suggested.....	45.00	43.00	41.00	39.00	37.00	36.00
Class D—						
10 hour restricted power	33.33	32.00	30.00	28.66	27.33	26.66
Suggested.....	34.00	32.00	30.00	28.00	27.00	26.00
Class E—						
Differential rate.....	.....	.....	.....	.....	.....	.....
Flat rate.....	15.00	14.40	13.80	13.20	12.60	12.00
Suggested flat rate.....	12.00	12.00	12.00	12.00	12.00	12.00
Meter rate.....	2.00	1.92	1.78	1.70	1.63	1.60
Suggested meter rate.....	2	2	2	2	2	2
Load factor to equate.....	55%	52%	47%	44%	42%	40%

BASE RATES FOR POWER—FIXED BY ALL MUNICIPALITIES—TABLE No. 2.

Horse Power of Motors Connected.	1 to 3 h.p.	3 to 10 h.p.	10 to 25 h.p.	25 to 50 h.p.	50 to 100 h.p.	100 h.p. upwards
Class A—						
24 hour unrestricted power per horse power per year	\$50.00	\$48.00	\$45.00	\$43.00	\$41.00	\$40.00
Class B—						
24 hour restricted power per horse power per year	45.00	43.00	41.00	39.00	37.00	36.00
Class C—						
10 hour unrestricted power per horse power per year	45.00	43.00	41.00	39.00	37.00	36.00
Class D—						
10 hour restricted power per horse power per year.....	34.00	32.00	30.00	28.00	27.00	26.00
Class E—						
Differential rate unrestricted as to hours of use.....	.....	.....	.....	.....	.....	.....

\$12.00 per horse power per year, and 2c. per horse power hour used.

From the above base rates used by all municipalities, the Corporation of the Town of (Woodstock) allows the following rates of discount, on total account rendered:—

Class A%	Class B%	Class C%
Class D%	Class E%	If payment be made
within ten days of date of account, a further cash discount of 10 per cent. will be allowed.		

Alternating Meter Readers.

It was also suggested at this meeting, that in instances where more than one meter reader is employed, a good check on the readings is secured by alternating the route covered by each of the meter readers. This recommendation was adopted.

Date for Meter Readings.

Date of Bills:—

It was further recommended that where the number of meters to be read warranted that meter reading be carried on through all the month, bills be sent out every day due in 10 days after date of bill. This would distribute the work of reading, billing and accounting over the entire month, and facilitate the work of the Department.

Special Class of Power Users.

It was the concensus of opinion that a special rate in accordance with peak and load conditions in each municipality be made for seven or eight months' power users, particularly those who heat by exhaust steam during four or five months of the year.

Length of Contract Adopted.

The minimum period of contract to be one year.

Five Year Contracts.

It was agreed that the minimum period of contract be one year, and that the basis for the price be fixed on the power anticipated to be sold at the end of the second year, and that in a five years' contract a clause be inserted guaranteeing that the rates will not advance more than 10 per cent. as an average during the first five years.

Classes A, B, C and D.

These are generally approved under the heading "Power Rates."

Class E Changes.

It was further agreed that the rates for Class E, should be scaled down in accordance with use and horse power connected up. and that four classes of service, the same as the four classes under flat rate with the corresponding ratios between prices, be established. Also that no restricted rates be given to users of 10 h.p. or less—this to apply to both flat and differential rates.

It was also decided that the differential rates should be given at a charge per kw-hr. instead of h.p. hour.

Suggestion re Power Factor.

It was suggested that a clause be inserted in the power contracts to read as follows:—Where it is necessary to consider power factor, the consumer who has a power factor of less than 75 per cent. may be penalized by the same method as that used in the contract between the Municipality and the H.E.P. Commission.

A letter from the Board of Light and Heat Commissioners of Guelph regarding power rates was referred to the Power Rates Committee for a report.

Report of Commercial Lighting Rates Committee.

A meeting of this Committee was held in London on January 5th, and after considerable discussion it was decided to recommend a double rate for commercial lighting, a certain rate per kw-hr. up to a daily one hour's use of the installed capacity and a low rate for all lighting in excess of this amount.

In explanation of this, we would say that, in making up the monthly bill, the installed capacity of the consumer, multiplied by 30, (i.e. one hour for each day of the month) will be used to determine the consumption to be charged at the high rate, while the low rate will be charged for all power consumed, per month, above this amount.

The proportion between these two rates was decided at 20c. and 5c. The rates themselves would vary in the different municipalities but it was found that at 12c. and 3c., London could easily compete with a rate of 9c. for all lighting. Bills at these small rates would compare very closely with the present bills in Woodstock at 8c. a kw-hr. and 20c. a month meter rent.

The various kinds of commercial lighting are covered as follows:—

Stores—20c. a kw-hr. for first hours daily use of installed capacity, and 5c. for each additional kw-hr.

Theatres—same.

Signs—same.

Display—Same.

Churches—one half above rate.

Factories—same if they are not buying power. If they are, add the transformer capacity to the connected load.

Hotels—same with some reduction due to distribution of load with some method to control the peak load.

The Committee acknowledges that specific instances may be cited which cannot be secured by these rates, but a thorough discussion is invited of the merits or faults of the plan suggested.

Commercial Lighting Rates.

This subject was re-considered with many arguments for and against the proposed rates. In order to secure more data on the subject it was moved and carried that each member investigate conditions in his own town to determine how the suggested method and the one similar to the house-lighting rates, would work out in a number of actual cases.

Price of Power in St. Thomas.

An application having been received by St. Thomas for 450 h.p. from the Michigan Central Railway Company for their shops, a general discussion of the terms of the contract was held and it was found that all of the important clauses of such a contract have been decided except the question of duration of peak load when buying power on a graphic recording meter. This was decided to be one minute for each 100 h.p. of the peak.

Seventh Meeting.

The seventh meeting of the Municipal Engineers was held in Toronto on January 25th and 26th, 1910, and called to order with the following municipalities represented:—St. Thomas, St. Mary's, Waterloo, Woodstock, Preston, Hespeler, Guelph, Berlin, London.

Commercial Lighting Rates.

The discussion on this subject was opened by the Committee reading the decision reached by them at their last meeting.

Resolved, that it be the recommendation of this Committee that the Commercial Lighting Rates proposed by this Committee at the St. Thomas meeting be adopted, with an amendment that window and sign lighting be optional with the customer, at these same rates or on a flat rate which will bring in \$6.00 per kw. connected up per month and renew all carbon lamps over and including 8 c.p.

During the discussion comparative reports were received from Guelph, Woodstock and Waterloo, comparing the annual bills of typical users under the different methods of charge. It was found that the square of floor area as a basis of the fixed charge was very difficult to adopt for this service, as there was no ratio fixed within reasonable limits between floor area and connected load.

After a full discussion the method of charge proposed by the Committee was adopted as the one recommended for use by all the municipalities.

Power Rates.

This discussion was opened by reading the schedule prepared by the Committee. This is given herewith:—

Schedule of Rates for Power.

Definitions:

- Class A—Unrestricted service, 24 hours a day.
- Class B—Restricted service, 24 hours a day.
- Class C—Unrestricted service, 10 hours a day.
- Class D—Restricted service, 10 hours a day.
- Rates under classes B. and D. do not apply to users of 10 h.p. or less.

Flat Rate Method of Charge.

H.P. of motors connected—	1-3	4-10	11-25	26-50	51-100	101 up.
Base Rates—	\$50.00	\$48.00	\$45.00	\$43.00	\$41.00	\$40.00
Class A—100 per cent. of Base Rates.	|		Class C—90 per cent. of Base Rates.			
“ B— 90 “ “ “			“ D—66 2/3 “ “ “			

Differential Method of Charge.

H.P. of motors connected—	1-3	4-10	11-25	26-50	51-100	101 up.
Base Rates { Charge a h.p. connected—	\$1.25	\$1.20	\$1.15	\$1.10	\$1.05	\$1.00.
“ { Charge a k.w. hr.—	3½c.	3c.	2½c.	2c.	1½c.	1½c.
Class A—100 per cent. of Base Rates.	|		Class C—90 per cent. of Base Rates.			
“ B— 90 “ “ “			“ D—66 2/3 “ “ “			

These are the base rates adopted by the Committee of Municipal Engineers. The City of will allow a discount of per cent. from these rates. A discount of 10 per cent. will be allowed from the net bill if payment is made within 10 days of the date of the bill.

A recommendation was also made, and provided that the report of the Engineers be made up by the Secretary and referred to the Hydro-Electric Power Commission for their approval; this to include decisions regarding power, commercial lighting and lighting methods of charge, etc., and also all decisions regarding electrical apparatus; a copy of this report to go to each of the municipalities.

Schedule of Rates for Power.

Copies of the schedule adopted at the previous meeting were distributed and discussed. One or two changes in the working were suggested. (These have been made in the schedule as given here.)

Regulation of Railway Board of Ottawa.

It was recommended that each municipality secure a copy of the regulations of the Dominion Railway Board and of the Ontario Railway and Municipal Board relating to crossings.

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